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RESEARCH MEMORANDUM

TESTS OF A TRIANGULAR WING OF ASPECT RATIO 2 IN THE

AMES 12-FOOT PRESSURE WIND TUNNEL. II - THE

EFFECTIVENESS AND HINGE MOMENTS OF A

CONSTANT-CHORD PLAIN FLAP

By Jack D. Stephenson and Arthur R. Amuedo

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Moffett Field, Calif.

NATIONAL ADVISORY COMMITTEE
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WASHINGTON
September 21, 1948

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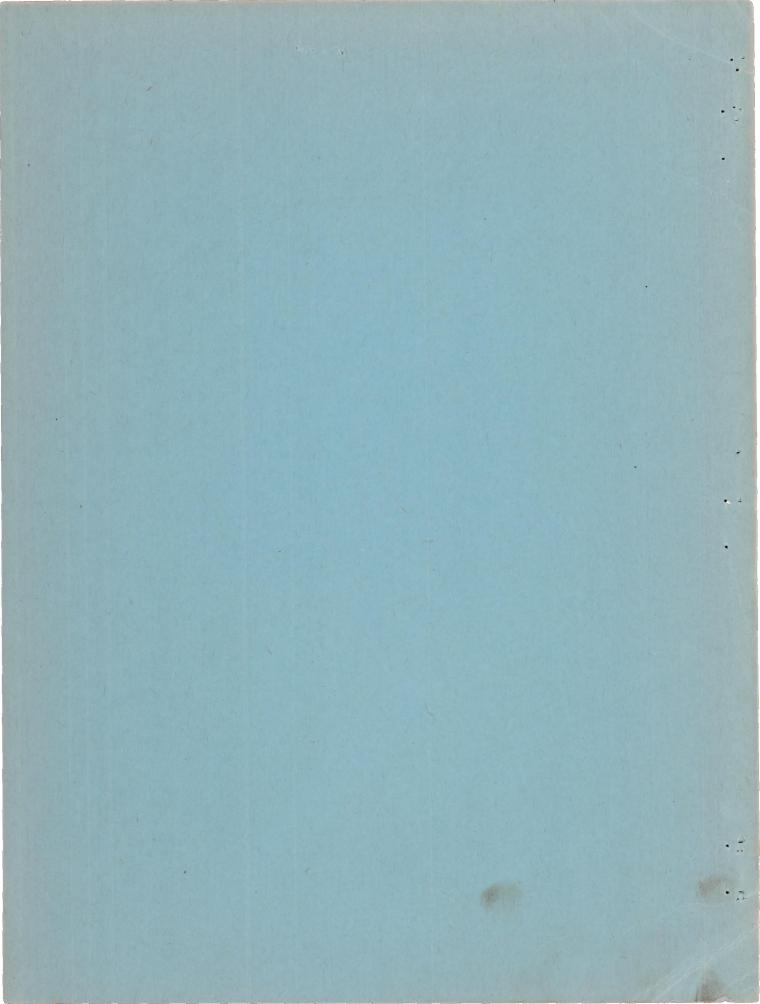
CONSTANT-CHORD PLAIN FLAP

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SUMMARY

A semispan triangular wing with a constant-chord trailing-edge flap was tested to evaluate the aerodynamic characteristics of such a wing from landing speeds up to a Mach number of 0.95. Tests were included to ascertain the effects of the addition of a body and of modifications to the airfoil section. Data are presented showing the lift, drag, and pitching-moment characteristics of the model for various flap deflections and the hinge-moment characteristics of the flap.

As the Mach number was increased from 0.18 to 0.95, the lift-curve slope increased by 0.01 per degree, and the aerodynamic center moved aft 5 percent of the mean aerodynamic chord. For the same increase in Mach number, the lift effectiveness of the flap increased 20 percent, and the pitching-moment effectiveness at a constant angle of attack increased 35 percent. At low speeds, the effectiveness of the flap was maintained to large deflections and large angles of attack, and changes in Reynolds number between 5,300,000 and 15,000,000 had no significant effect.

The rate of change of hinge-moment coefficient with angle of attack had a large negative value and became more negative with increasing Mach number. The rate of change of hinge-moment coefficient with control-flap deflection had a low-speed value of −0.013 and a value of −0.022 at a Mach number of 0.95.

Data from the tests have been applied to the calculation of the longitudinal-stability and -control characteristics of an airplane

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geometrically similar to the wing-body model. The calculations
indicate that effective longitudinal control could be provided by the
constant-chord control surface at all speeds, but the hinge-moment
characteristics were such as to require a powerful irreversible
actuator.

INTRODUCTION

In various investigations of the characteristics of wings
designed to operate at moderate supersonic speeds, it has been shown
that the low-aspect-ratio triangular wing offers several advantages.
The low aspect ratio and high taper result in structural problems
less serious than those usually associated with thin wings designed
for these speeds. The beneficial effects of sweep at supersonic
speeds, low-pressure drag, and low drag due to lift have been shown
to be theoretically possible for the triangular wing with the apex
forward and the leading edge swept well behind the Mach wave
(reference 1). Compared with high-aspect-ratio wings having the
same amount of sweep, the triangular wing gives evidence of superior
longitudinal-stability characteristics at high lift coefficients.

This report presents results of tests in the Ames 12-foot
pressure wind tunnel of a triangular wing equipped with a plain
constant-chord trailing-edge flap. Tests of the same model with an
undeflected flap were described in reference 2.

SYMBOLS

The following symbols are used in this report:

C_D drag coefficient $\left(\dfrac{drag}{qS}\right)$

C_h hinge-moment coefficient $\left(\dfrac{hinge\ moment}{qb_f\bar{c}_f{}^2}\right)$

C_L lift coefficient $\left(\dfrac{lift}{qS}\right)$

C_m pitching-moment coefficient about the quarter-chord point of
the wing mean aerodynamic chord $\left(\dfrac{pitching\ moment}{qSc'}\right)$

H hinge moment, foot-pounds

M Mach number $\left(\dfrac{V}{a}\right)$

R   Reynolds number $\left(\dfrac{\rho V c'}{\mu}\right)$

g   acceleration due to gravity, feet per second per second

n   normal acceleration, feet per second per second

α angle of attack of the wing chord line, degrees

δ angle of the flap from the wing chord line, degrees

δ_u flap angle uncorrected for distortion, degrees

S   area of the semispan wing, square feet

V   airspeed, feet per second

a   speed of sound, feet per second

b   wing semispan, feet

b_f span of the flap, feet

c   local chord, feet

c'   wing mean aerodynamic chord, M.A.C. $\left(\dfrac{\int_{0}^{b} c^2 dy}{S}\right)$, feet

$\overline{c}_f$ root-mean-square chord of the flap aft of the hinge line, feet

q   dynamic pressure $\left(\dfrac{1}{2}\rho V^2\right)$, pounds per square foot

y   spanwise station, feet

μ coefficient of viscosity of air, slugs per foot-second

ρ mass density of air, slugs per cubic foot

MODEL AND APPARATUS

The tests described in this report were conducted in the Ames 12-foot pressure tunnel, which is a variable-density wind tunnel having a circular test section modified by the addition of four equally spaced flat sections of 4-foot chord. The characteristics and performance of the wind tunnel are discussed in reference 2.

The semispan triangular wing, which was constructed of steel, was mounted on a turntable in the flat section on the tunnel floor. The unmodified wing had 5—percent—thick, uncambered, double—wedge sections with the maximum thickness at 20 percent of the chord. A limited amount of data was obtained with the leading edge sharp and the ridge line (line of maximum thickness) sharp, and with the leading edge sharp and the ridge line rounded to a radius of 32.22 percent of the chord. The major portion of the data was obtained with the ridge line rounded to a radius of 32.22 percent and the leading edge rounded to a radius of 0.25 percent of the chord. Figure 1 shows the dimensions corresponding to the three profiles. Figures 2 and 3 are photographs of the model in the test section illustrating these modifications. Dimensional constants used in defining the coefficients for the model are given in table I.

A wing—body combination was formed by the addition of half of a body of revolution, mounted symmetrically on the wing, as shown in figure 4. The coordinates of the body are also shown in this figure.

A constant—chord flap having an area aft of the hinge line of 1.8 square feet (20 percent of the original unmodified wing area) was supported on three hinges and restrained from rotation at the inboard end by an electric strain—gage unit and an angle—indexing bracket. (See fig. 2.) The flap had a radius nose with no aerodynamic balance and an unsealed nose gap of 0.028 inch (0.37 percent of the flap chord). Flap angles in increments of 2° from 30° to -30° could be set by means of the indexing bracket. In tests of the wing—body combination, the flap extended into the fuselage through a cover plate which was changed for each flap setting. It was necessary to leave clearance in the plates to allow for the deflection of the flap due to the aerodynamic load. These gaps averaged about five—eighths inch in width at the trailing edge and tapered to a small clearance at the hinge line.

The gap between the wing root and test—section floor was between 0.01 and 0.15 inch where the wing root extended beyond the turntable; consequently, some air leakage was possible. The boundary layer on the tunnel floor, the displacement thickness of which was 0.5 inch at the model, was not removed.

CORRECTIONS TO DATA

Corrections have been applied to the data to account for the effects of tunnel—wall interference, constriction of the air stream, tare forces on the model—support plate, and distortion of the flap

under load. All corrections except that for the distortion are the
same as those used in reference 2 and are summarized as follows:

Tunnel—Wall Corrections (Added)

$$\Delta\alpha = 0.722 \, C_L$$

$$\Delta C_D = 0.0107 \, C_L^2$$

$$\Delta C_m = 0$$

Constriction Corrections

The following table gives the uncorrected Mach number and the
ratio of corrected dynamic pressure to the uncorrected dynamic
pressure corresponding to the Mach numbers for which data are
presented:

Corrected Mach number	Uncorrected Mach number		$\dfrac{q, \text{ corrected}}{q, \text{ uncorrected}}$	
	Wing alone	Wing and body	Wing alone	Wing and body
0.40	0.400	0.400	1.000	1.000
.50	.500	.500	1.000	1.008
.60	.600	.600	1.000	1.010
.70	.699	.695	1.000	1.012
.80	.797	.790	1.004	1.018
.85	.845	.835	1.006	1.024
.90	.892	.877	1.009	1.034
.93	.918	.899	1.013	1.043
.95	.933	.912	1.017	1.052

Tare Corrections

Tare corrections were applied to account for the turntable drag
but not for aerodynamic interference between the model and the turn—
table. The tare—drag coefficients were found to vary with Reynolds
number only. The values are as follows:

Reynolds number	Tare–drag coefficient	
	Wing alone	Wing and body
5.3×10^6	0.0032	0.0022
15×10^6	.0028	.0018

No correction was applied for the effect of air leakage between the turntable and the tunnel, although there was some evidence that this leakage may have affected the drag data slightly.

Flap–Distortion Corrections

Angular deflection of the flap under load was known to be appreciable because of the low rigidity of the restraining bracket and the flap itself. In order to determine the magnitude of the distortion, measurements were made of the angular displacement, at three spanwise stations, of the flap under aerodynamic loading. This was done by measuring, with the model in the air stream, the deflection of beams of light reflected from mirrors on the flap at each station. The distortion of the flap as a whole, which was assumed to be the average of the values at the three stations, was then correlated with the hinge moment. The distortion data were obtained only when the test section was approximately at atmospheric pressure and, therefore, at relatively low Mach number. The effect upon the correction of changes in the load distribution resulting from changes in Mach number was not considered because the mean torsional deformation of the flap was found to be small compared with the angular deflection originating in the restraining bracket. Since the flap was set by means of an indexing head which maintained fixed no–load angles, each series of data was for a small range of flap angles. Data for constant flap angles or constant angles of attack were obtained by interpolating graphically between test points. Care was taken to preserve any irregularities, so that the uniformity of the test points within any one curve is typical of the uncorrected data.

TESTS

Tests were made to ascertain the lift, drag, and pitching–moment characteristics of the model and the hinge–moment characteristics of the flap as they are influenced by changes in Reynolds number and Mach number. The flap could be deflected throughout a range of angles from $-30°$ to $+30°$, but at the higher Mach numbers and higher dynamic pressures the range was limited by the strain–gage capacity and by excessive vibration of the flap. The angle of attack was varied from

−10° to +30° for the wing–alone tests, and from −18° to +18° for tests with the wing–body combination. These ranges were also reduced at high speed because of the excessive hinge loads, vibration, and limitations of wind–tunnel power.

Data were obtained at constant Mach numbers from 0.18 to 0.95 with the tunnel at the pressures required for a Reynolds number of about 5,300,000, the highest Reynolds number for which high Mach number data could be obtained over a moderate angle–of–attack range. At the lowest Mach number, 0.18, the effect of increasing the Reynolds number to 15,000,000 was determined.

RESULTS AND DISCUSSION

Tests have been made to investigate the characteristics of the wing alone and the wing in combination with the fuselage under the variety of conditions within the capacity of the 12–foot pressure tunnel. Initial tests showed that the effects of some changes were quite small, permitting the elimination of certain portions of the test program. As shown in reference 2, changes in Reynolds number from 3,500,000 to 5,300,000, the maximum extent possible at high Mach number, had practically no effect, and a change from 15,000,000 to 27,500,000 at 0.18 Mach number caused only a small decrease in drag coefficient and little change in other data. Because the pitching moment of the wing at high angles of attack seemed to be affected by Mach number even at low speeds, tests were made at several Mach numbers for which ordinarily no effects of compressibility would be expected.

Results are presented graphically in this report for a representative series of test conditions, and data are tabulated for intermediate conditions. Except for a limited number of curves which show a comparison of the data obtained with the slightly modified airfoil sections, the data are for the wing having the leading edge rounded to a radius of 0.0025c and the ridge line rounded to a radius of 0.3222c.

Wing Alone, Low Mach Number

Angle of attack, drag coefficient, and pitching–moment coefficient as functions of the lift coefficient, and hinge–moment coefficient as a function of angle of attack are presented in figures 5 through 10 for the wing alone and in figures 11 through 16 for the wing with the fuselage. Similar data for intermediate test conditions are presented in tables II through IX.

Figure 5 shows that the effectiveness of the flap in producing
lift and pitching moment at low Mach number was maintained throughout
the range of flap angles from −24° to +24°. When the angle of attack
was increased to 14°, the pitching—moment curves indicate that there
was a sudden forward shift in the center of pressure accompanied by a
slight loss in lift. The shift became greater and more abrupt as the
flap was deflected to increase the lift. The angle of attack at which
the shift occurred was not influenced by a change in Reynolds number
from 15,000,000 to 5,300,000. (Compare figs. 5 and 6.) An investiga—
tion of the causes of the break in the pitching—moment curves of a
similar triangular—wing model is described in reference 3.

As the flap was deflected to angles over 12°, the minimum drag
began to increase and the variation of drag with lift became somewhat
greater (fig. 6(b)). The lift coefficient for minimum drag changed
slightly with flap angle, increasing with positive deflection of the
flap. Figure 6(c) shows that the variation of hinge—moment coeffi—
cient with angle of attack was negative and large. Within the range
of flap angles between ±12°, the curves are smooth except at the
angle of attack where the break in the pitching—moment curve occurred.

Wing Alone, High Mach Number

The aerodynamic characteristics of the wing alone at Mach
numbers of 0.70, 0.85, 0.93, and 0.95 are presented in figures 7
through 10. Below the angle of attack at which the center of
pressure shifted suddenly, there were nearly linear variations of
angle of attack and pitching—moment coefficient with lift coefficient
over a wide range of flap settings. As the Mach number was increased,
the slopes of the lift curves increased gradually, and the slopes of
the pitching—moment curves became increasingly negative. The control
flap remained effective throughout the whole range of Mach numbers.
The shift in the center of pressure occurred at approximately a
constant angle of attack regardless of flap angle for any one Mach
number. As the Mach number was increased, this discontinuity was
delayed to higher angles of attack, but the abruptness and extent of
the center—of—pressure shift became greater. A comparison of the
drag data at various Mach numbers shows that the drag rise with lift
decreased slightly with increasing Mach number. When the flap was
deflected more than 6°, there was a considerably greater increase in
minimum drag coefficient with Mach number than that for the model
with the flap neutral.

The large negative variation of hinge moment with angle of
attack became greater as the Mach number increased, particularly for

the higher angles of attack. A divergence of the curves for constant
flap angle at the higher Mach numbers indicates increased hinge—
moment variation with flap deflection.

Effect of the Body

Data obtained with the wing—body combination are presented for a
Reynolds number of 15,000,000 at a Mach number of 0.18 (fig. 11), and
for a Reynolds number of 5,300,000 at Mach numbers of 0.30, 0.70,
0.85, 0.93, and 0.95 (figs. 12 through 16). Addition of the body
caused a slight reduction of the static longitudinal stability and an
increase of the minimum drag, but did not change the lift or the shape
of the drag curves. The variation of hinge moment with angle of attack
was slightly greater than that measured for the wing alone, probably
because of the pressure differential over a part of the flap within
the fuselage.

Effect of the Flap

Variations of lift coefficient, pitching—moment coefficient, and
hinge—moment coefficient with flap deflection at zero angle of attack
are shown in figures 17 and 18. Figure 17 shows low Mach number data
for the wing alone and the wing—body combination at a Reynolds number
of 15,000,000. Data obtained at a Reynolds number of 5,300,000 are
presented in figure 18 for a series of Mach numbers from 0.18 to 0.95.
The lift and pitching—moment coefficients varied linearly over a large
range of flap angles, the effectiveness increasing somewhat with Mach
number. The hinge—moment curves decreased (algebraically) in slope
fairly rapidly with increases in Mach number, particularly for negative
flap angles beyond -4°. The effect of adding the body was to cause a
slight reduction in flap effectiveness but to increase slightly the
absolute value of the variation of hinge—moment coefficient with flap
deflection.

Effect of Mach Number

Figure 19 shows how the lift, pitching moment, and hinge moment
varied with Mach number at an angle of attack of 0° for several
constant flap angles. For flap angles greater than 4°, the hinge—
moment coefficient underwent considerable change with Mach number;
whereas the changes in lift and pitching—moment coefficients were
relatively small.

The minimum drag coefficients are shown in figure 20 as a function of Mach number for several flap angles. The large increase in minimum drag with flap deflection, when the Mach number exceeded 0.60, suggests an important loss in wing efficiency if large flap angles are required in order to provide balance. A similar loss would result from large positive deflections if the flap were used as a lift—producing device in this speed range.

Figure 21 shows the variation with Mach number of lift—curve slope and aerodynamic center. The lift—curve slope at zero lift and 0.18 Mach number was 0.038, becoming greater with an increase in either lift coefficient or Mach number. The aerodynamic center began to move aft at 0.40 Mach number until at 0.95 Mach number the total displacement was 5 percent of the mean aerodynamic chord. Figure 22 shows the variation with Mach number of the lift effectiveness $\partial C_L/\partial\delta$, the pitching—moment effectiveness $\partial C_m/\partial\delta$, and the location of the aerodynamic center of the load due to the flap, measured at zero angle of attack and within a range of flap angles near zero. As the Mach number increased from 0.50 to 0.95, data for the wing—body combination showed an increase of 20 percent in lift effectiveness, an increase of 35 percent in pitching—moment effectiveness, and an aft movement of the aerodynamic center of the loading due to control—surface deflection amounting to 6 percent of the mean aerodynamic chord.

Slopes of the curves of hinge—moment coefficient against angle of attack $\partial C_h/\partial\alpha$, measured with the flap undeflected, and hinge—moment coefficient against flap angle $\partial C_h/\partial\delta$, measured at zero angle of attack, are plotted in figure 23. There was a decrease of about 20 percent in the algebraic value of $\partial C_h/\partial\alpha$ as the Mach number was increased from 0.18 to 0.90. The value of $\partial C_h/\partial\delta$ decreased algebraically with increasing Mach number, the decrease becoming more pronounced as the Mach number exceeded 0.90. At a Mach number of 0.95, $\partial C_h/\partial\delta$ was 160 percent of the low—speed value.

Lift—Drag Ratio

Figure 24 presents the variation of lift—drag ratio with lift coefficient for the wing—body combination at three Mach numbers: 0.18, 0.30, and 0.93. This variation affords a measure of the efficiency of the configuration when the flap is deflected, either to provide balance or to obtain increases in lift. Since the model was symmetrical about the chord plane, the curves may be used to represent positive flap angles by reversing the signs of the axes. It is evident that the loss in lift—drag ratio accompanying negative flap deflections is important if it becomes necessary to deflect the flap in the direction

such as to reduce the lift in order to provide longitudinal balance, and that a substantial gain in lift–drag ratio could be realized if the movable surface were deflected to positive angles and used as a landing flap. In addition to improving the lift–drag ratio, the use of the surface as a landing flap offers a means of avoiding the excessive angles of attack otherwise required in landing (fig. 11(a)). The effect of adding a horizontal surface, which would be necessary to balance the pitching moment due to the flap, must be included in any evaluation of the gain in lift–drag ratio associated with these positive flap deflections. At a Mach number of 0.93, improvement in the lift–drag ratio resulting from the effective camber due to a down-deflection of the flap was offset by the increase in minimum drag with flap deflection. The lift–drag ratios of the triangular wing were low under all conditions, and the maximum values for the wing–body combination, which occurred at a lift coefficient of about 0.2, were never greater than 11.

Wing–Profile Modifications

Figures 25 through 28 indicate the aerodynamic effects of slightly modifying the wing profile. Curves presented in these figures are uncorrected for flap distortion, the effect of which was investigated only for the wing with a rounded leading edge and rounded ridge lines. In the investigation of the effects of the modifications to the airfoil section, the wing was first tested with true double–wedge sections and was subsequently tested with two alterations, rounded ridge lines, and a rounded leading edge with the rounded ridge lines. (See fig. 1.) Effects of the modification are noticeable only at the higher angles of attack and, in particular, above the angle at which the discontinuity in the pitching–moment curve appears (fig. 25). Rounding the leading edge resulted in a slightly reduced lift–curve slope and an increase in the static stability at the higher angles of attack. The center-of–pressure shift occurred at a somewhat lower angle of attack for the rounded profile. Only small changes in hinge–moment characteristics resulted from the modifications (fig. 27), the principal differences appearing at the angles of attack near the center–of–pressure shift. There was no apparent effect of rounding the ridge lines.

APPLICATION OF DATA

Data from the tests have been used in the calculation of the stability, maneuverability, control–flap hinge moments, and sinking speeds of a tailless airplane employing a triangular wing in flight at subsonic speeds. The airplane was chosen to be geometrically

similar to the model tested with the fuselage and the wing with
rounded leading edge and ridge lines. Dimensions of the airplane
were assumed to be as follows:

Wing area . . . . 500 sq ft

Wing span . . . . 31.91 ft

Control–flap area . . . . 90.80 sq ft

Flap hinge moment . . . . 281.8 C_{hq} ft–lb

Consideration of the requirements for longitudinal control to
be provided by the constant–chord flap led to the assumption of an
irreversible control actuator. This assumption was a result of the
hinge–moment investigation, which indicated that the stick–free
neutral point was a considerable distance ahead of the aerodynamic
center of the wing. If the center of gravity were located sufficiently
far forward to obviate the need for irreversible controls, the large
up–elevator angles required for level flight would impose serious
limitations on the maneuverability of the airplane and result in
high drag due to the large angles of attack. A center of gravity at
32 percent of the mean aerodynamic chord was chosen, based upon the
requirement for the maximum maneuverability without allowing the
airplane to become unstable (with irreversible controls) at low speed.

Figure 29 shows the lift coefficient, the hinge moment, and the
control–flap angle as a function of Mach number for the airplane in
level flight at 30,000 feet altitude. Although the flap–angle
variation is stable over the range below 0.93 Mach number, the
control–force variations indicate marginal stability. If a trim tab
were used to trim out the large push force, stick–free instability
would result at all Mach numbers. The control–surface angles and
control forces required in a constant–speed maneuver which produces
a change in the normal acceleration are shown in figure 30 for
various Mach numbers from 0.60 to 0.95. It is assumed that the
airplane has a wing loading of 60 pounds per square foot and is
operating at 30,000 feet altitude. The control–flap angle necessary
to increase the normal acceleration becomes greater at the higher
accelerations for the Mach numbers above 0.70, indicating the effect
of the increase in static stability at high Mach number and high
angles of attack. At the lower speeds, increasing push forces are
required as the normal acceleration is increased. The nonlinear
variation of control–flap angle with normal acceleration factor at
the higher Mach numbers, larger angles being required at high lift,
results in the reversal of the slopes of the control hinge–moment

curves. At the highest Mach numbers, 0.93 and 0.95, a large
(negative) change in $\partial C_h / \partial \delta$ causes the floating angle to be
reduced to the extent that a pull force is needed for balance in the
maneuver. The sharp rise in hinge moment with increase in normal
acceleration above 2.8g at a Mach number of 0.95 indicates that
structural requirements of the control actuator may be a major
problem, if even moderate maneuverability is to be attained at this
speed.

The steep power—off gliding angle resulting from a low lift—
drag ratio at high angles of attack is one of the objectionable
characteristics associated with this type of airplane. Figure 31
shows the sinking speed, hinge moment for balance, control—flap
angle, and angle of attack as a function of gliding speed at sea
level. The minimum power—off sinking speed for the lightest wing
loading considered, 20 pounds per square foot, is 32 feet per second,
and occurs at a forward speed of 190 miles per hour. For the 40—pound
wing loading, the minimum sinking speed is 45 feet per second at a
forward speed of 270 miles per hour. Reference 4 indicates that some
reduction in the vertical speed during a landing would result from
the large ground effect upon the triangular wing. However, figure 31
shows that even the moderate wing loadings which were assumed result
in sinking speeds that are substantially greater than those thought
to be safe for piloted airplanes (reference 5). The data indicate
that considerable difficulty may be experienced by a pilot of an
airplane employing a low—aspect—ratio triangular wing in landing
without power.

CONCLUSIONS

The following conclusions have been drawn from the results of
tests of a triangular wing model with a constant—chord plain flap:

1. At low speeds, the flap was effective in producing changes
in lift and pitching moment to deflections as large as 24°. Changes
in Reynolds number between 5,300,000 and 15,000,000 had little
effect, except at flap angles over 20°.

2. Increasing the Mach number from 0.18 to 0.95 caused the
aerodynamic center to move rearward about 5 percent of the mean aero—
dynamic chord and the slope of the lift curve to increase by about
0.01 per degree.

3. For the wing—body combination, the lift effectiveness of the
flap increased with Mach number by 20 percent of the low—speed value,
and the pitching—moment effectiveness at a constant angle of attack
increased 35 percent between Mach numbers of 0.18 and 0.95.

4. The variation of hinge—moment coefficient with angle of attack was negative and large under all conditions, and its algebraic value decreased 20 percent between Mach numbers of 0.18 and 0.90.

5. A considerable change with Mach number was found for the variation of hinge—moment coefficient with flap deflection. At a Mach number of 0.95, this variation had increased to 160 percent of the low—speed value.

6. The lift—drag ratios were generally low and were reduced considerably by upward deflections of the flap, such as are required to balance a tailless airplane in flight. At low speeds, an improvement in the lift—drag ratio resulted from small positive deflections, but at the higher Mach numbers the improvement was offset by the rise in minimum drag with flap deflection.

7. For a given Mach number, the sudden shift of the center of pressure of the wing occurred at about the same angle of attack for all flap angles. Increasing the Mach number delayed the shift to higher angles of attack and caused the abruptness and amount of the shift to increase.

8. Calculations were made of the characteristics of a tailless airplane consisting of a triangular wing with a fuselage and using a constant—chord plain flap for longitudinal control. Results of the calculations may be summarized as follows:

(a) The hypothetical airplane had a stable variation of control—flap angle with speed until the Mach number exceeded 0.93.

(b) At Mach numbers below 0.90 with the center of gravity at 32 percent of the mean aerodynamic chord, a large variation of flap hinge moment with angle of attack resulted in stick—free instability and, unless an irreversible type of control actuator were employed, large push forces would be required in a maneuver to increase the normal acceleration. The effect of increasing the Mach number above 0.90 was to cause the push forces to diminish and then become pull forces.

(c) The forward speeds and sinking speeds associated with the low—aspect—ratio triangular wing in a power—off approach were so large as to indicate that some power

would have to be applied if a safe landing were to be
accomplished.

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TABLE I – MODEL GEOMETRIC DATA

Area of semispan wing, S
  With rounded leading edge . . . . 8.84 sq ft
  With sharp leading edge. . . . . 9 sq ft

Mean aerodynamic chord, c'
  With rounded leading edge . . . . 3.93 ft
  With sharp leading edge . . . . 4 ft

Wing semispan, b . . . . 3 ft

Root–mean–square chord of the flap, $\overline{c}_f$
  Wing alone . . . . 0.6107 ft
  Wing and body . . . . 0.6043 ft

Span of the flap, b_f
  Wing alone . . . . 3 ft
  Wing and body . . . . 2.565 ft

Table II.– Aerodynamic characteristics of a triangular wing with various flap angles. Reynolds number, 5,300,000; Mach number, 0.50.

δ	a	C_L	C_D	C_m	C_h	δ	a	C_L	C_D	C_m	C_h
0	-10	-0.463	0.078	0.071	-0.090	8	-10	-0.259	0.045	-0.024	-0.030
0	-8	-.360	.050	.057	.073	8	-8	-.160	.027	-.036	-.046
0	-6	-.264	.028	.044	.056	8	-6	-.065	.014	-.050	-.063
0	-4	-.169	.016	.028	.038	8	-4	.023	.010	-.065	-.082
0	-2	-.085	.008	.015	.021	8	-2	.110	.010	-.077	-.099
0	0	-.005	.007	.003	.003	8	0	.190	.016	-.090	-.115
0	2	.075	.009	-.011	-.016	8	2	.275	.024	-.104	-.132
0	4	.162	.014	-.022	-.032	8	4	.368	.039	-.121	-.156
0	6	.255	.026	-.037	-.049	8	6	.470	.064	-.137	-.178
0	8	.352	.048	-.051	-.064	8	8	.570	.092	-.151	-.196
0	10	.453	.076	-.062	-.083	8	10	.669	.129	-.164	-.208
0	12	.550	.111	-.075	-.098	8	12	.770	.175	-.175	-.225
0	14	.648	.153	-.086	-.114	8	14	.864	.225	-.186	-.241
0	16	.740	.200	-.092	-.123	8	16	.965	.284	-.197	-.257
0	18	.809	.253	-.096	-.156	8	18	1.065	.350	-.209	-.271
0	20	.895	.313	-.109	-.184	8	20	1.094	.405	-.192	-.301
0	22	.982	.380	-.121	-.199	8	22	1.148	.466	-.192	-.312
0	24	1.060	.453	-.132	-.210	8	24	1.221	.540	-.204	-.316
0	26	1.138	.530	-.139	-.228	8	26	1.280	.616	-.209	-.327
0	28	1.190	.606	-.148	-.248	8	28	1.308	.698	-.213	-.334
0	30	1.228	.684	-.159	-.266	8	30	1.338	.774	-.221	-.359
2	-10	-.412	.680	.045	.060	12	-10	-.165	.040	-.066	-.080
2	-8	-.310	.420	.033	.042	12	-8	-.068	.024	-.078	-.096
2	-6	-.216	.230	.019	.025	12	-6	.029	.014	-.093	-.113
2	-4	-.120	.120	.005	.009	12	-4	.120	.014	-.108	-.131
2	-2	-.035	.007	-.008	-.008	12	-2	.215	.019	-.121	-.151
2	0	-.042	.008	-.020	-.026	12	0	.281	.027	-.132	-.165
2	2	.127	.011	-.033	-.045	12	2	.362	.039	-.144	-.181
2	4	.213	.019	-.044	-.061	12	4	.458	.058	-.159	-.206
2	6	.305	.034	-.061	-.079	12	6	.560	.087	-.180	-.232
2	8	.405	.058	-.075	-.096	12	8	.661	.120	-.195	-.250
2	10	.505	.087	-.085	-.113	12	10	.760	.160	-.207	-.266
2	12	.601	.125	-.100	-.128	12	12	.855	.208	-.217	-.280
2	14	.700	.169	-.112	-.144	12	14	.948	.262	-.228	-.296
2	16	.800	.220	-.125	-.158	12	16	1.048	.325	-.239	-.312
2	18	.858	.275	-.118	-.184	12	18	1.137	.389	-.237	-.321
2	20	.940	.336	-.129	-.212	12	20	1.141	.437	-.219	-.341
2	22	1.028	.402	-.142	-.228	12	22	1.196	.500	-.214	-.350
2	24	1.102	.474	-.152	-.236	12	24	1.262	.592	-.231	-.356
2	26	1.179	.546	-.159	-.251	12	26	1.313	.645	-.233	-.363
2	28	1.225	.622	-.167	-.270	12	28	1.343	.724	-.235	-.376
2	30	1.242	.697	-.173	-.285	12	30	---	---	---	.394
4	-10	-.360	.058	.021	.030	20	-10	0	.038	-.150	-.222
4	-8	-.260	.036	.010	.013	20	-8	.100	.031	-.162	-.242
4	-6	-.165	.019	-.004	-.004	20	-6	.200	.031	-.178	-.257
4	-4	-.071	.010	-.018	-.020	20	-4	.290	.039	-.189	-.284
4	-2	.013	.008	-.051	-.037	20	-2	.362	.050	-.200	-.302
4	0	.093	.010	-.044	-.055	20	0	.430	.063	-.205	-.311
4	2	.178	.014	-.056	-.076	20	2	.495	.080	-.212	-.321
4	4	.266	.025	-.072	-.093	20	4	.565	.100	-.221	-.330
4	6	.360	.042	-.085	-.111	20	6	.615	.138	-.240	-.386
4	8	.459	.067	-.099	-.130	20	8	.830	.186	-.278	-.421
4	10	.559	.100	-.114	-.145	20	10	.925	.234	-.289	-.437
4	12	.658	.140	-.127	-.162	20	12	1.019	.287	-.299	-.446
4	14	.755	.187	-.140	-.178	20	14	1.107	.347	-.307	-.458
4	16	.861	.242	-.151	-.198	20	16	1.200	.410	-.312	-.464
4	18	.916	.300	-.145	-.216	20	18	1.210	.448	---	-.464
4	20	1.008	.362	-.154	-.242	20	20	1.230	.497	---	-.468
4	22	1.079	.425	-.165	-.260	20	22	1.290	.602	---	-.478
4	24	1.155	.499	-.172	-.267	20	24	1.339	.659	---	-.485
4	26	1.229	.574	-.177	-.279	20	26	1.380	.727	---	-.487
4	28	1.257	.645	-.186	-.300	20	28	1.399	.801	---	-.499
4	30	1.289	.731	-.191	-.312						

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δ	a	C_L	C_D	C_m	C_h	δ	a	C_L	C_D	C_m	C_h
-2	-10	-0.512	0.090	0.093	0.120	-12	-10	-0.754	0.157	0.206	0.282
-2	-8	-.410	.059	.081	.102	-12	-8	-.654	.117	.194	.264
-2	-6	-.311	.035	.068	.086	-12	-6	-.556	.083	.179	.246
-2	-4	-.217	.020	.051	.067	-12	-4	-.457	.056	.161	.223
-2	-2	-.131	.010	.038	.051	-12	-2	-.353	.036	.143	.190
-2	0	-.051	.008	.024	.032	-12	0	-.271	.024	.128	.170
-2	2	.028	.008	.011	.014	-12	2	-.189	.016	.116	.155
-2	4	.111	.011	0	-.004	-12	4	-.104	.014	.102	.135
-2	6	.204	.022	-.014	-.020	-12	6	-.013	.015	.089	.117
-2	8	.302	.041	-.028	-.037	-12	8	.081	.024	.075	.100
-2	10	.401	.066	-.041	-.052	-12	10	.181	.038	.062	.081
-2	12	.497	.098	-.052	-.068	-12	12	.274	.062	.050	.065
-2	14	.596	.137	-.063	-.083	-12	14	.372	.093	.040	.050
-2	16	.680	.182	-.066	-.093	-12	16	.461	.127	.030	.029
-2	18	.760	.234	-.074	-.129	-12	18	.560	.171	.019	.001
-2	20	.850	.294	-.089	-.153	-12	20	.648	.226	.004	-.019
-2	22	.939	.260	-.101	-.168	-12	22	.740	.284	-.008	-.037
-2	24	1.018	.430	-.111	-.183	-12	24	.821	.346	-.021	-.056
-2	26	1.093	.503	-.120	-.203	-12	26	.900	.414	-.034	-.077
-2	28	1.151	.582	-.131	-.224	-12	28	.975	.488	-.047	-.098
	30	1.209	.660	-.144	-.246	-12	30	1.030	.565	-.064	-.122
-4	-10	-.560	.101	.115	.146	-16	-10	-.840	.192	.248	.352
-4	-8	-.458	.068	.103	.130	-16	-8	-.747	.148	.237	.333
-4	-6	-.360	.043	.090	.113	-16	-6	-.646	.110	.223	.314
-4	-4	-.265	.025	.073	.094	-16	-4	-.538	.078	.203	.276
-4	-2	-.177	.013	.059	.076	-16	-2	-.433	.054	.180	.238
-4	0	-.095	.009	.045	.060	-16	0	-.354	.039	.169	.238
-4	2	-.017	.008	.033	.043	-16	2	-.276	.030	.159	.218
-4	4	.066	.009	.021	.024	-16	4	-.190	.022	.147	.198
-4	6	.157	.019	.007	.006	-16	6	-.102	.019	.133	.176
-4	8	.252	.035	-.006	-.010	-16	8	-.008	.024	.119	.160
-4	10	.350	.059	-.020	-.026	-16	10	.090	.037	.104	.141
-4	12	.450	.088	-.031	-.040	-16	12	.182	.056	.093	.121
-4	14	.545	.124	-.040	-.055	-16	14	.282	.082	.082	.104
-4	16	.629	.167	-.045	-.066	-16	16	.370	.113	.072	.081
-4	18	.711	.218	-.052	-.100	-16	18	.470	.154	.056	.058
-4	20	.805	.276	-.068	-.122	-16	20	.560	.204	.041	.035
-4	22	.895	.342	-.080	-.137	-16	22	.658	.259	.028	.013
-4	24	.975	.410	-.090	-.153	-16	24	.743	.319	.013	-.019
-4	26	1.050	.481	-.102	-.172	-16	26	.825	.385	-.002	-.043
-4	28	1.110	.553	-.114	-.196	-16	28	.899	.456	-.015	-.061
-4	30	1.155	.630	-.127	-.218	-16	30	---	---	---	---
-8	-10	-.658	.126	.160	.201	-20	-10	-.910	.232	.279	---
-8	-8	-.555	.091	.147	.185	-20	-8	-.815	.187	.267	---
-8	-6	-.458	.061	.133	.167	-20	-6	-.709	.146	.253	.393
-8	-4	-.361	.038	.117	.147	-20	-4	-.595	.105	.226	.320
-8	-2	-.264	.022	.100	.123	-20	-2	-.498	.078	.207	.320
-8	0	-.179	.014	.086	.107	-20	0	-.412	.064	.198	.320
-8	2	-.096	.010	.072	.090	-20	2	-.348	.050	.190	.316
-8	4	-.012	.008	.060	.070	-20	4	-.259	.036	.178	.274
-8	6	.076	.015	.047	.054	-20	6	-.179	.031	.165	.250
-8	8	.171	.028	.033	.039	-20	8	-.085	.032	.151	.228
-8	10	.272	.046	.020	.020	-20	10	.015	.041	.139	.206
-8	12	.368	.074	.008	.004	-20	12	.108	.056	.126	.186
-8	14	.465	.108	-.005	-.011	-20	14	.207	.079	.115	.167
-8	16	.553	.147	-.008	-.029	-20	16	.300	.108	.103	.139
-8	18	.650	.195	-.021	-.060	-20	18	.394	.146	.089	.111
-8	20	.735	.252	-.036	-.080	-20	20	.486	.190	.075	.088
-8	22	.827	.314	-.047	-.095	-20	22	.580	.242	.061	.064
-8	24	.908	.380	-.058	-.113	-20	24	.672	.300	.047	.044
-8	26	.981	.450	-.070	-.133	-20	26	.757	.366	.031	.022
-8	28	1.050	.525	-.085	-.155	-20	28	.835	.435	.015	-.006
-8	30	1.109	.602	-.098	-.179	-20	30	---	---	---	---

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Table III.- Aerodynamic characteristics of a triangular wing with various flap angles. Reynolds number, 5,300,000; Mach number, 0.60.

δ	a	C_L	C_D	C_m	C_h	δ	a	C_L	C_D	C_m	C_h
0	28	1.189	0.608	-0.157	-0.257	8	28	1.302	0.682	-0.210	-0.368
0	26	1.139	.536	-.153	-.240	8	26	1.274	.614	-.208	-.354
0	24	1.072	.457	-.141	-.234	8	24	1.210	.536	-.202	-.343
0	22	1.005	.387	-.133	-.231	8	22	1.158	.461	-.193	-.320
0	20	.960	.328	-.130	-.180	8	20	1.111	.416	-.205	-.308
0	18	.869	.267	-.115	-.152	8	18	1.078	.359	-.217	-.290
0	16	.769	.211	-.107	-.132	8	16	.980	.291	-.209	-.271
0	14	.665	.157	-.095	-.114	8	14	.881	.230	-.195	-.254
0	12	.564	.112	-.081	-.099	8	12	.782	.174	-.180	-.240
0	10	.463	.078	-.067	-.081	8	10	.682	.132	-.173	-.224
0	8	.361	.050	-.055	-.064	8	8	.579	.094	-.159	-.208
0	6	.262	.028	-.040	-.048	8	6	.475	.064	-.145	-.189
0	4	.156	.015	-.023	-.034	8	4	.378	.040	-.129	-.167
0	2	.077	.010	-.012	-.019	8	2	.288	.026	-.109	-.141
0	0	-.006	.007	.001	.004	8	0	.200	.018	-.095	-.120
0	-2	-.080	.008	.015	.021	8	-2	.112	.012	-.081	-.104
0	-4	-.170	.015	.028	.038	8	-4	.030	.010	-.067	-.085
0	-6	-.268	.028	.045	.056	8	-6	-.062	.014	-.054	-.068
0	-8	-.373	.051	.061	.075	8	-8	-.162	.029	-.040	-.052
0	-10	-.476	.079	.075	.094	8	-10	-.249	.049	-.027	-.032
2	28	1.223	.618	-.181	-.286	12	28	---	---	---	---
2	26	1.180	.549	-.173	-.268	12	26	---	---	---	---
2	24	1.112	.477	-.160	-.259	12	24	---	---	---	---
2	22	1.050	.406	-.151	-.255	12	22	---	---	---	---
2	20	1.026	.356	-.157	-.210	12	20	1.148	.448	-.223	-.360
2	18	.934	.289	-.147	-.194	12	18	1.155	.403	-.256	-.344
2	16	.828	.224	-.134	-.175	12	16	1.069	.333	-.249	-.330
2	14	.723	.173	-.121	-.157	12	14	.969	.270	-.238	-.314
2	12	.622	.125	-.107	-.138	12	12	.870	.213	-.230	-.302
2	10	.520	.088	-.092	-.120	12	10	.771	.166	-.218	-.288
2	8	.416	.058	-.080	-.101	12	8	.670	.124	-.208	-.274
2	6	.320	.035	-.065	-.084	12	6	.565	.088	-.187	-.252
2	4	.219	.019	-.046	-.066	12	4	.461	.059	-.168	-.221
2	2	.127	.012	-.036	-.050	12	2	.375	.041	-.151	-.198
2	0	.042	.008	-.023	-.031	12	0	.300	.030	-.143	-.181
2	-2	-.035	.007	-.010	-.012	12	-2	.209	.021	-.127	-.164
2	-4	-.122	.012	.003	.007	12	-4	.121	.015	-.112	-.143
2	-6	-.214	.024	.018	.024	12	-6	.027	.016	-.096	-.125
2	-8	-.316	.044	.034	.042	12	-8	-.071	.026	-.082	-.108
2	-10	-.421	.070	.048	.061	12	-10	-.152	.041	-.070	-.089
4	28	1.255	.640	-.199	-.317	16	28	1.349	.755	-.265	-.450
4	26	1.218	.572	-.190	-.300	16	26	1.319	.688	-.265	-.445
4	24	1.148	.496	-.180	-.292	16	24	1.279	.610	-.250	-.441
4	22	1.091	.424	-.175	-.274	16	22	1.225	.533	-.227	-.437
4	20	1.079	.378	-.182	-.247	16	20	1.225	.478	-.254	-.416
4	18	.988	.309	-.173	-.232	16	18	1.199	.442	-.293	-.408
4	16	.881	.244	-.161	-.215	16	16	1.138	.374	-.286	-.408
4	14	.780	.191	-.147	-.196	16	14	1.044	.309	-.276	-.395
4	12	.678	.140	-.132	-.176	16	12	.946	.252	-.269	-.381
4	10	.578	.100	-.121	-.159	16	10	.853	.202	-.258	-.367
4	8	.472	.069	-.107	-.141	16	8	.751	.157	-.255	-.350
4	6	.372	.044	-.090	-.120	16	6	.642	.116	-.218	-.333
4	4	.275	.025	-.070	-.104	16	4	.528	.081	-.184	-.280
4	2	.182	.015	-.060	-.082	16	2	.439	.061	-.176	-.265
4	0	.095	.011	-.046	-.064	16	0	.368	.047	-.179	-.255
4	-2	.008	.010	-.033	-.044	16	-2	.285	.035	-.167	-.242
4	-4	-.069	.008	-.020	-.023	16	-4	.204	.027	-.153	-.220
4	-6	-.160	.019	-.007	-.005	16	-6	.111	.023	-.137	-.202
4	-8	-.262	.038	.009	.008	16	-8	.014	.029	-.123	-.178
4	-10	-.364	.062	.021	.027	16	-10	-.078	.039	-.110	-.162

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δ	a	C_L	C_D	C_m	C_h		δ	a	C_L	C_D	C_m	C_h
-2	28	1.151	0.587	-0.141	-0.237		-12	28	0.979	0.492	-0.057	-0.100
-2	26	1.095	.511	-.131	-.215		-12	26	.904	.424	-.043	-.081
-2	24	1.030	.435	-.121	-.197		-12	24	.835	.348	-.031	-.064
-2	22	.935	.361	-.069	-.192		-12	22	.750	.286	-.016	-.046
-2	20	.840	.288	-.090	-.159		-12	20	.659	.223	-.002	-.029
-2	18	.769	.235	-.077	-.120		-12	18	.566	.170	.017	-.003
-2	16	.710	.194	-.078	-.098		-12	16	.470	.126	.031	.033
-2	14	.608	.143	-.068	-.083		-12	14	.379	.091	.039	.051
-2	12	.509	.102	-.055	-.070		-12	12	.283	.063	.050	.068
-2	10	.406	.069	-.044	-.054		-12	10	.187	.042	.062	.084
-2	8	.304	.042	-.030	-.038		-12	8	.088	.025	.075	.102
-2	6	.208	.023	-.015	-.020		-12	6	-.020	.016	.091	.122
-2	4	.106	.012	0	-.004		-12	4	-.100	.013	.107	.138
-2	2	.029	.008	.011	.011		-12	2	-.188	.018	.120	.161
-2	0	-.050	.007	.024	.033		-12	0	-.282	.026	.134	.179
-2	-2	-.121	.010	.039	.051		-12	-2	-.359	.037	.144	.190
-2	-4	-.223	.020	.051	.066		-12	-4	-.454	.056	.165	.230
-2	-6	-.321	.035	.067	.088		-12	-6	-.563	.086	.186	.254
-2	-8	-.418	.061	.084	.109		-12	-8	-.660	.120	.201	.278
-2	-10	-.545	.095	.098	.132		-12	-10	-.761	.160	.214	.293
-4	28	1.118	.566	-.124	-.205		-16	28	.889	.455	-.021	-.047
-4	26	1.059	.492	-.112	-.185		-16	26	.821	.389	-.008	-.028
-4	24	.978	.413	-.102	-.168		-16	24	.744	.324	.005	-.006
-4	22	.910	.346	-.088	-.159		-16	22	.662	.265	.021	.016
-4	20	.818	.280	-.070	-.138		-16	20	.568	.207	.037	.036
-4	18	.726	.221	-.058	-.100		-16	18	.475	.158	.058	.060
-4	16	.662	.180	-.054	-.071		-16	16	.381	.117	.071	.094
-4	14	.574	.133	-.049	-.060		-16	14	.282	.083	.080	.117
-4	12	.472	.093	-.036	-.043		-16	12	.191	.059	.092	.135
-4	10	.370	.060	-.020	-.027		-16	10	.092	.041	.104	.154
-4	8	.265	.036	-.006	-.012		-16	8	0	.027	.116	.177
-4	6	.167	.020	.010	.005		-16	6	-.101	.022	.132	.199
-4	4	.067	.011	.022	.026		-16	4	-.188	.023	.146	.215
-4	2	-.010	.008	.034	.044		-16	2	-.269	.031	.160	.245
-4	0	-.090	.008	.047	.062		-16	0	-.362	.042	.172	.259
-4	-2	-.172	.013	.062	.081		-16	-2	-.431	.057	.180	.265
-4	-4	-.272	.026	.075	.098		-16	-4	-.536	.077	.199	.295
-4	-6	-.367	.043	.092	.120		-16	-6	-.641	.111	.223	.338
-4	-8	-.480	.071	.107	.137		-16	-8	-.740	.149	.240	.356
-4	-10	-.587	.104	.121	.152		-16	-10	-.839	.195	.253	.373
-8	28	1.038	.525	-.092	-.161							
-8	26	.981	.454	-.079	-.138							
-8	24	.910	.385	-.067	-.118							
-8	22	.829	.318	-.054	-.106							
-8	20	.742	.256	-.037	-.086							
-8	18	.652	.201	-.020	-.058							
-8	16	.568	.152	-.010	-.024							
-8	14	.475	.113	-.005	-.012							
-8	12	.377	.077	.007	.005							
-8	10	.276	.049	.018	.022							
-8	8	.179	.029	.033	.039							
-8	6	.079	.016	.048	.062							
-8	4	-.010	.010	.061	.077							
-8	2	-.092	.010	.074	.092							
-8	0	-.177	.015	.088	.110							
-8	-2	-.267	.023	.103	.126							
-8	-4	-.361	.038	.121	.153							
-8	-6	-.462	.062	.137	.176							
-8	-8	-.562	.092	.153	.196							
-8	-10	-.661	.129	.166	.211							

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Table IV.-Aerodynamic characteristics of a triangular wing with various flap angles. Reynolds number, 5,300,000; Mach number, 0.80.

δ	α	C_L	C_D	C_m	C_h	δ	α	C_L	C_D	C_m	C_h
0	20	0.962	0.344	-0.130	-0.206	-4	20	0.812	0.302	-0.094	-0.160
0	18	.900	.295	-.149	-.178	-4	18	.759	.243	-.069	-.105
0	16	.825	.233	-.137	-.168	-4	16	.714	.198	-.071	-.086
0	14	.715	.177	-.119	-.149	-4	14	.612	.147	-.052	-.070
0	12	.610	.127	-.104	-.130	-4	12	.502	.105	-.048	-.053
0	10	.502	.088	-.086	-.107	-4	10	.395	.069	-.032	-.035
0	8	.392	.056	-.067	-.084	-4	8	.290	.042	-.010	-.015
0	6	.286	.033	-.048	-.060	-4	6	.175	.023	.004	.004
0	4	.182	.018	-.031	-.042	-4	4	.081	.012	.019	.022
0	2	.088	.010	-.016	-.022	-4	2	0	.009	.032	.042
0	0	.001	.008	0	-.001	-4	0	-.084	.009	.048	.064
0	-2	-.075	.009	.013	.016	-4	-2	-.180	.015	.063	.080
0	-4	-.176	.016	.029	.035	-4	-4	-.274	.026	.081	.105
0	-6	-.281	.031	.047	.058	-4	-6	-.383	.046	.099	.128
0	-8	-.392	.055	.065	.081	-4	-8	-.491	.074	.120	.155
0	-10	-.498	.086	.084	.100	-4	-10	-.600	.110	.157	.179
2	20	1.010	.362	-.153	-.243	-8	20	.761	.272	-.052	-.106
2	18	.960	.314	-.173	-.212	-8	18	.674	.213	-.029	-.065
2	16	.878	.254	-.166	-.203	-8	16	.580	.166	-.016	-.017
2	14	.775	.194	-.149	-.191	-8	14	.511	.130	-.015	0
2	12	.665	.144	-.133	-.172	-8	12	.413	.088	-.002	.012
2	10	.556	.101	-.115	-.146	-8	10	.308	.058	.011	.030
2	8	.450	.066	-.095	-.123	-8	8	.193	.035	.031	.050
2	6	.340	.040	-.075	-.101	-8	6	.086	.019	.049	.073
2	4	.235	.022	-.057	-.079	-8	4	-.012	.012	.067	.090
2	2	.143	.013	-.042	-.056	-8	2	-.098	.014	.080	.114
2	0	.044	.008	-.026	-.035	-8	0	-.186	.018	.098	.134
2	-2	-.033	.009	-.012	-.016	-8	-2	-.276	.027	.115	.159
2	-4	-.120	.013	.003	0	-8	-4	-.382	.044	.138	.186
2	-6	-.223	.026	.019	.022	-8	-6	-.489	.068	.157	.214
2	-8	-.335	.047	.038	.044	-8	-8	-.597	.100	.177	.248
2	-10	-.444	.075	.055	.064	-8	-10	-.691	.142	.195	.274
4	20	1.050	.384	-.177	-.287	-12	20	.675	.250	-.009	-.029
4	18	1.009	.335	-.200	-.251	-12	18	.575	.197	.014	.003
4	16	.928	.275	-.196	-.245	-12	16	.486	.149	.034	.049
4	14	.831	.214	-.181	-.234	-12	14	.403	.111	.042	.085
4	12	.721	.162	-.163	-.214	-12	12	.308	.078	.050	.100
4	10	.614	.116	-.145	-.188	-12	10	.209	.054	.063	.117
4	8	.508	.078	-.125	-.166	-12	8	.101	.034	.083	.139
4	6	.395	.049	-.105	-.143	-12	6	-.003	.024	.100	.164
4	4	.290	.029	-.085	-.119	-12	4	-.092	.020	.113	.185
4	2	.192	.017	-.069	-.092	-12	2	-.190	.025	.126	.217
4	0	.095	.012	-.053	-.071	-12	0	-.271	.029	.143	.241
4	-2	.012	.009	-.037	-.050	-12	-2	-.353	.044	.155	.260
4	-4	-.078	.011	-.023	-.036	-12	-4	-.442	.064	.171	.279
4	-6	-.175	.021	-.007	-.014	-12	-6	-.558	.091	.197	.314
4	-8	-.278	.041	.012	.009	-12	-8	-.669	.128	.218	.360
4	-10	-.388	.068	.029	.030	-12	-10	---	---	---	---
-2	20	.853	.320	-.111	-.179	-16	20	.608	.239	.028	.064
-2	18	.814	.263	-.102	-.128	-16	18	.512	.188	.048	.095
-2	16	.753	.215	-.108	-.124	-16	16	.419	.141	.068	.137
-2	14	.659	.161	-.091	-.108	-16	14	.328	.108	.081	.178
-2	12	.551	.115	-.076	-.089	-16	12	.238	.078	.088	.200
-2	10	.450	.078	-.058	-.069	-16	10	.142	.063	.096	.218
-2	8	.339	.048	-.039	-.049	-16	8	.039	.041	.109	---
-2	6	.232	.027	-.022	-.027	-16	6	-.103	.030	.128	.260
-2	4	.132	.014	-.006	-.010	-16	4	-.143	.031	.144	.285
-2	2	.041	.008	.008	.009	-16	2	-.231	.037	.155	.305
-2	0	-.040	.009	.024	.033	-16	0	-.313	.047	.168	.323
-2	-2	-.129	.011	.037	.048	-16	-2	-.399	.060	.179	.336
-2	-4	-.224	.020	.055	.070	-16	-4	-.482	.082	.192	.347
-2	-6	-.332	.038	.075	.093	-16	-6	---	---	---	---
-2	-8	-.440	.064	.094	.118	-16	-8	---	---	---	---
-2	-10	-.549	.098	.119	.138	-16	-10	---	---	---	---

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Table V.– Aerodynamic characteristics of a triangular wing with various flap angles. Reynolds number, 5,300,000; Mach number, 0.90.

δ	a	C_L	C_D	C_m	C_h	δ	a	C_L	C_D	C_m	C_h
2	12	---	0.160	-0.176	---	-6	12	0.490	0.109	-0.036	-0.021
2	10	---	.113	-.156	---	-6	10	.373	.072	-.014	.005
2	8	.486	.078	-.116	-0.150	-6	8	.265	.044	.008	.031
2	6	.372	.047	-.092	-.115	-6	6	.156	.025	.029	.050
2	4	.269	.027	-.070	-.089	-6	4	.037	.015	.047	.073
2	2	.153	.016	-.052	-.067	-6	2	-.053	.013	.066	.103
2	0	.063	.011	-.036	-.048	-6	0	-.145	.016	.082	.129
2	-2	-.027	.010	-.020	-.028	-6	-2	-.238	.024	.100	.160
2	-4	-.125	.015	-.001	-.010	-6	-4	-.340	.034	.122	.202
2	-6	-.235	.030	.018	.014	-6	-6	-.450	.060	.142	.236
2	-8	-.348	.051	.051	.040						
2	-10	-.466	.083	.068	.069						
						-8	12	.437	-.007	.103	.039
						-8	10	.324	.014	.067	.067
0	12	.675	.142	.140	-.164	-8	8	.207	.036	.042	.088
0	10	.540	.098	-.109	-.132	-8	6	.101	.056	.026	.114
0	8	.420	.062	-.082	-.101	-8	4	-.005	.072	.018	.147
0	6	.307	.036	-.060	-.071	-8	2	-.096	.090	.018	.175
0	4	.202	.019	-.040	-.050	-8	0	-.191	.107	.023	.201
0	2	.099	.012	-.021	-.028	-8	-2	-.283	.125	.334	.236
0	0	.008	.009	-.006	-.009	-8	-4	-.385	.148	.052	.278
0	-2	-.085	.010	.013	.012						
0	-4	-.182	.018	.032	.035						
0	-6	-.292	.034	.052	.056	-10	12	.387	.098	.020	.117
0	-8	-.407	.059	.075	.085	-10	10	.274	.060	.040	.140
0	-10	-.525	.094	.104	.117	-10	8	.163	.042	.060	.162
						-10	6	.057	.029	.079	.184
						-10	4	-.042	.022	.096	.205
-2	12	.601	.127	-.102	-.120	-10	2	-.136	.023	.113	.232
-2	10	.475	.086	-.073	-.082	-10	0	-.230	.031	.130	.259
-2	8	.357	.052	-.049	-.055	-10	-2	-.321	.042	.147	.297
-2	6	.247	.030	-.028	-.030	-10	-4	-.421	.063	.169	.342
-2	4	.142	.016	-.009	-.012						
-2	2	.044	.010	.010	.009						
-2	0	-.047	.095	.025	.032	-12	12	.344	.096	.046	.188
-2	-2	-.140	.013	.043	.056	-12	10	.237	.065	.065	.200
-2	-4	-.241	.024	.074	.081	-12	8	.131	.045	.082	.217
-2	-6	-.348	.040	.084	.103	-12	6	.026	.033	.099	.232
-2	-8	-.460	.067	.106	.137	-12	4	-.070	.027	.116	.255
-2	-10	-.578	.103	.136	.171	-12	2	-.165	.029	.132	.281
						-12	0	-.260	.037	.150	.313
						-12	-2	-.350	.050	.166	.355
-4	12	.546	.117	-.068	-.073	-12	-4	-.445	.072	.188	.400
-4	10	.422	.076	-.043	-.041						
-4	8	.306	.047	-.020	-.013						
-4	6	.197	.027	.001	.008						
-4	4	.086	.015	.020	.025	-16	12	.272	.102	.088	.299
-4	2	-.006	.011	.039	.047	-16	10	.171	.074	.103	.300
-4	0	-.097	.012	.054	.077	-16	8	.071	.053	.113	.301
-4	-2	-.190	.018	.073	.100	-16	6	-.026	.042	.130	.317
-4	-4	-.295	.028	.094	.131	-16	4	-.136	---	.148	.350
-4	-6	-.400	.049	.115	.160	-16	2	-.230	---	---	---
-4	-8	-.511	.075	.134	.197						
-4	-10	-.636	.112	.167	---						

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Table VI.- Aerodynamic characteristics of a triangular wing and a fuselage for various flap angles. Reynolds number, 5,300,000; Mach number, 0.50.

δ	a	C_L	C_D	C_m	C_h	δ	a	C_L	C_D	C_m	C_h
4	-16	-0.624	0.169	0.046	0.096	-8	-16	-0.865	0.255	0.159	0.276
4	-14	-.536	.126	.036	.067	-8	-14	-.821	.221	.166	.254
4	-12	-.447	.091	.029	.050	-8	-12	-.718	.161	.149	.234
4	-10	-.357	.062	.020	.033	-8	-10	-.619	.119	.145	.217
4	-8	-.263	.039	.008	.016	-8	-8	-.524	.085	.134	.200
4	-6	-.165	.024	-.006	.000	-8	-6	-.426	.059	.120	.181
4	-4	-.070	.014	-.019	-.021	-8	-4	-.329	.038	.106	.157
4	-2	.003	.012	-.030	-.040	-8	-2	-.238	.025	.089	.130
4	0	.082	.014	-.040	-.062	-8	0	-.158	.018	.075	.108
4	2	.166	.019	-.051	-.084	-8	2	-.075	.014	.064	.087
4	4	.255	.029	-.066	-.105	-8	4	.007	.014	.056	.067
4	6	.360	.045	-.080	-.125	-8	6	.098	.020	.040	.046
4	8	.445	.070	-.092	-.144	-8	8	.193	.032	.028	.027
4	10	.543	.101	-.106	-.164	-8	10	.290	.054	.016	.009
4	12	.638	.137	-.116	-.182	-8	12	.386	.080	.005	-.007
4	14	.743	.183	-.114	-.190	-8	14	.475	.112	-.005	-.029
4	16	.835	.225	-.122	-.230	-8	16	.563	.152	-.018	-.053
4	18	.850	.288	-.130	-.244	-8	18	.658	.202	-.029	-.073
0	-16	-.701	.192	.078	.152	-12	-16	-.942	.287	.195	.339
0	-14	-.617	.148	.070	.117	-12	-14	-.904	.244	.213	.326
0	-12	-.526	.108	.065	.103	-12	-12	-.804	.193	.197	.309
0	-10	-.432	.075	.054	.086	-12	-10	-.715	.149	.188	.292
0	-8	-.337	.050	.043	.069	-12	-8	-.614	.111	.179	.279
0	-6	-.240	.030	.030	.050	-12	-6	-.517	.079	.164	.256
0	-4	-.145	.017	.017	.030	-12	-4	-.417	.054	.146	.219
0	-2	-.066	.012	.006	.011	-12	-2	-.324	.038	.129	.189
0	0	.015	.011	-.005	-.008	-12	0	-.243	.026	.116	.172
0	2	.092	.013	-.016	-.028	-12	2	-.160	.020	.107	.153
0	4	.178	.019	-.028	-.049	-12	4	-.078	.016	.096	.132
0	6	.267	.033	-.038	-.068	-12	6	.013	.020	.082	.107
0	8	.362	.054	-.056	-.086	-12	8	.107	.029	.067	.086
0	10	.456	.081	-.065	-.103	-12	10	.207	.046	.054	.066
0	12	.550	.113	-.077	-.119	-12	12	.297	.069	.041	.047
0	14	.626	.150	-.077	-.132	-12	14	.392	.098	.034	.032
0	16	.715	.198	-.087	-.165	-12	16	.484	.136	.021	-.002
0	18	.801	.251	-.108	-.184	-12	18	.582	.182	.007	-.023
-2	-16	-.742	.206	.099	.182	-16	-16	-.977	.317	.221	.395
-2	-14	-.678	.163	.095	.150	-16	-14	-.953	.259	.230	.390
-2	-12	-.572	.120	.085	.133	-16	-12	-.883	.226	.236	.390
-2	-10	-.477	.084	.075	.116	-16	-10	-.792	.181	.230	.377
-2	-8	-.381	.057	.065	.098	-16	-8	-.705	.140	.223	.362
-2	-6	-.284	.035	.050	.079	-16	-6	-.602	.105	.207	.336
-2	-4	-.192	.021	.036	.060	-16	-4	-.496	.073	.182	.278
-2	-2	-.106	.013	.024	.039	-16	-2	-.401	.053	.165	.258
-2	0	-.026	.011	.014	.020	-16	0	-.320	.040	.155	.248
-2	2	.052	.012	.004	.000	-16	2	-.246	.031	.149	.230
-2	4	.137	.017	-.008	-.020	-16	4	-.163	.024	.137	.201
-2	6	.226	.029	-.021	-.039	-16	6	-.072	.023	.124	.179
-2	8	.321	.048	-.035	-.057	-16	8	.020	.029	.111	.156
-2	10	.414	.073	-.047	-.074	-16	10	.119	.041	.096	.132
-2	12	.508	.103	-.056	-.088	-16	12	.213	.061	.083	.109
-2	14	.584	.149	-.057	-.101	-16	14	.310	.087	.069	.075
-2	16	.670	.183	-.068	-.133	-16	16	.409	.121	.054	.052
-2	18	.766	.236	-.079	-.153	-16	18	.505	.163	.042	.029
-4	-16	-.782	.221	.122	.213						
-4	-14	-.732	.178	.122	.186						
-4	-12	-.620	.132	.100	.166						
-4	-10	-.524	.095	.099	.148						
-4	-8	-.430	.065	.088	.130						
-4	-6	-.332	.042	.073	.111						
-4	-4	-.237	.025	.060	.092						
-4	-2	-.150	.016	.047	.069						
-4	0	-.070	.013	.034	.048						
-4	2	.008	.012	.025	.028						
-4	4	.093	.015	.012	.007						
-4	6	.184	.025	-.001	-.013						
-4	8	.279	.041	-.013	-.031						
-4	10	.373	.065	-.026	-.048						
-4	12	.470	.095	-.036	-.063						
-4	14	.545	.129	-.040	-.079						
-4	16	.633	.170	-.050	-.106						
-4	18	.729	.223	-.061	-.126						

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Table VII.-Aerodynamic characteristics of a triangular wing and a fuselage for various flap angles. Reynolds number, 5,300,000 ; Mach number, 0.60.

δ	a	C_L	C_D	C_m	C_h	δ	a	C_L	C_D	C_m	C_h
4	-16	-0.635	0.172	0.034	0.103	-8	-16	-0.880	0.255	0.176	0.282
4	-14	-.543	.130	.050	.061	-8	-14	-.831	.217	.169	.261
4	-12	-.458	.094	.030	.050	-8	-12	-.730	.165	.164	.242
4	-10	-.365	.063	.019	.032	-8	-10	-.632	.123	.154	.225
4	-8	-.265	.041	.006	.025	-8	-8	-.536	.088	.138	.213
4	-6	-.160	.024	-.007	-.005	-8	-6	-.432	.060	.125	.190
4	-4	-.072	.013	-.021	-.026	-8	-4	-.330	.039	.107	.162
4	-2	.010	.011	-.032	-.045	-8	-2	-.235	.025	.090	.131
4	0	.092	.014	-.043	-.066	-8	0	-.157	.018	.077	.110
4	2	.175	.020	-.054	-.088	-8	2	-.077	.014	.066	.090
4	4	.268	.030	-.068	-.111	-8	4	.010	.014	.053	.069
4	6	.355	.047	-.083	-.134	-8	6	.100	.021	.041	.047
4	8	.458	.073	-.099	-.154	-8	8	.195	.035	.028	.028
4	10	.550	.104	-.112	-.174	-8	10	.295	.056	.014	.008
4	12	.645	.143	-.122	-.194	-8	12	.393	.083	.003	-.007
4	14	.760	.171	-.135	-.217	-8	14	.485	.114	-.004	-.025
4	16	.870	.248	---	-.232	-8	16	.572	.159	-.017	-.057
4	18	.912	.301	-.144	-.254	-8	18	.670	.207	-.030	-.073
0	-18	-.797	.252	.094	.178	-12	-16	-1.022	.291	.218	.351
0	-16	-.710	.196	.073	.161	-12	-14	-.915	.251	---	.338
0	-14	-.630	.152	.085	.123	-12	-12	-.815	.192	.207	.320
0	-12	-.543	.111	.070	.108	-12	-10	-.722	.152	.198	.304
0	-10	-.440	.077	.059	.089	-12	-8	-.629	.115	.189	.292
0	-8	-.341	.050	.046	.070	-12	-6	-.527	.082	.173	.270
0	-6	-.245	.031	.033	.050	-12	-4	-.414	.054	.152	.223
0	-4	-.147	.017	.019	.031	-12	-2	-.320	.035	.136	.203
0	-2	-.063	.013	.007	.010	-12	0	-.243	.025	.123	.184
0	0	.017	.011	-.004	-.010	-12	2	-.162	.020	.109	.160
0	2	.095	.014	-.015	-.030	-12	4	-.078	.016	.097	.135
0	4	.180	.020	-.029	-.051	-12	6	.015	.019	.084	.115
0	6	.270	.024	-.041	-.070	-12	8	.110	.031	.070	.091
0	8	.370	.054	-.056	-.091	-12	10	.205	.048	.057	.067
0	10	.465	.082	-.070	-.108	-12	12	.305	.070	.044	.051
0	12	.560	.116	-.081	-.127	-12	14	.403	.101	.033	.022
0	14	.660	.157	-.092	-.144	-12	16	.490	.138	.017	-.003
0	16	.740	.206	-.094	-.173	-12	18	.592	.184	.005	-.014
0	18	.804	.258	-.106	-.192						
-2	-18	-.836	.267	.115	.211	-16	-16	-.986	.328	.255	.397
-2	-16	-.750	.211	.106	.191	-16	-14	-.990	.294	---	.396
-2	-14	-.690	.170	.102	.163	-16	-12	-.896	.233	.244	.394
-2	-12	-.590	.123	.092	.139	-16	-10	-.803	.189	.237	.388
-2	-10	-.485	.086	.081	.119	-16	-8	-.708	.149	.230	.380
-2	-8	-.386	.057	.068	.101	-16	-6	-.600	.108	.214	.357
-2	-6	-.290	.036	.053	.080	-16	-4	-.488	.070	.181	.288
-2	-4	-.192	.021	.039	.060	-16	-2	-.396	.055	.169	.278
-2	-2	-.109	.014	.027	.038	-16	0	-.326	.040	.159	.268
-2	0	-.025	.012	.015	.018	-16	2	-.247	.030	.152	.245
-2	2	.050	.012	.004	-.002	-16	4	-.163	.026	.139	.221
-2	4	.140	.018	-.008	-.022	-16	6	-.072	.024	.126	.200
-2	6	.230	.029	-.021	-.040	-16	8	.020	.030	.112	.165
-2	8	.326	.048	-.036	-.060	-16	10	.120	.044	.100	.138
-2	10	.422	.074	-.048	-.077	-16	12	.220	.064	.086	.117
-2	12	.519	.106	-.060	-.093	-16	14	.320	.091	.070	.082
-2	14	.601	.145	-.066	-.103	-16	16	.420	.127	.054	.055
-2	16	.686	.191	-.072	-.144	-16	18	.465	.171	.041	.030
-2	18	.770	.243	-.085	-.162						
-4	-18	-.875	.282	.137	.246						
-4	-16	-.788	.225	.131	.223						
-4	-14	-.741	.184	.121	.197						
-4	-12	-.635	.136	.116	.173						
-4	-10	-.531	.097	.104	.153						
-4	-8	-.435	.066	.090	.136						
-4	-6	-.335	.042	.076	.115						
-4	-4	-.238	.026	.060	.090						
-4	-2	-.150	.017	.046	.067						
-4	0	-.070	.012	.035	.046						
-4	2	.001	.012	.024	.027						
-4	4	.095	.015	.012	.008						
-4	6	.185	.026	.001	-.013						
-4	8	.283	.043	-.014	-.032						
-4	10	.380	.066	-.027	-.049						
-4	12	.475	.098	-.039	-.064						
-4	14	.555	.133	-.043	-.074						
-4	16	.651	.181	-.053	-.115						
-4	18	.750	.232	-.066	-.132						

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Table VIII.- Aerodynamic characteristics of a triangular wing and a fuselage for various flap angles. Reynolds number, 5,300,000; Mach number, 0.80.

δ	a	C_L	C_D	C_m	C_h
4	-16	-0.645	0.183	0.051	---
4	-14	-.567	.140	.051	.063
4	-12	-.485	.102	.038	.047
4	-10	-.381	.070	.023	.031
4	-8	-.278	.044	.006	.009
4	-6	-.170	.026	-.008	-.014
4	-4	-.073	.017	-.030	-.037
4	-2	.020	.014	-.042	-.057
4	0	.117	.018	-.054	-.080
4	2	.197	.023	-.067	-.100
4	4	.285	.034	-.081	-.131
4	6	.385	.054	-.101	-.162
4	8	.495	.080	-.120	-.192
4	10	.596	.112	-.138	-.222
4	12	.690	.155	-.161	-.245
4	14	.781	.199	-.178	-.265
4	16	.828	.253	---	-.279
4	18	---	---	---	-.347
-2	-16	-.745	.230	.143	---
-2	-14	-.722	.183	.127	.181
-2	-12	-.630	.136	.115	.163
-2	-10	-.724	.096	.092	.139
-2	-8	-.414	.063	.079	.117
-2	-6	-.307	.038	.059	.090
-2	-4	-.203	.022	.042	.065
-2	-2	-.112	.015	.028	.042
-2	0	-.026	.012	.017	.019
-2	2	.054	.014	.004	-.003
-2	4	.147	.019	-.011	-.024
-2	6	.246	.033	-.027	-.044
-2	8	.350	.053	-.043	-.065
-2	10	.453	.083	-.060	-.087
-2	12	.554	.118	-.073	-.105
-2	14	.641	.159	-.078	-.116
-2	16	.704	.205	-.079	-.149
-2	18	---	.250	---	-.178
-8	-16	-1.000	.280	.231	---
-8	-14	-.878	.235	.214	.285
-8	-12	-.786	.187	.201	.284
-8	-10	-.687	.140	.186	.273
-8	-8	-.582	.101	.167	.255
-8	-6	-.466	.069	.149	.229
-8	-4	-.360	.045	.124	.187
-8	-2	-.265	.030	.106	.162
-8	0	-.165	.022	.086	.137
-8	2	-.081	.018	.075	.114
-8	4	.001	.017	.061	.084
-8	6	.104	.025	.045	.062
-8	8	.210	.038	.029	.040
-8	10	.310	.059	.013	.018
-8	12	.411	.087	.002	.002
-8	14	.498	.128	-.007	-.033
-8	16	.588	.171	-.024	-.075
-8	18	.696	.222	-.054	-.110

δ	a	C_L	C_D	C_m	C_h
0	-14	-0.667	0.165	0.098	0.141
0	-12	-.579	.122	.087	.123
0	-10	-.472	.085	.069	.102
0	-8	-.366	.054	.054	.079
0	-6	-.258	.032	.035	.054
0	-4	-.156	.019	.019	.031
0	-2	-.064	.014	.005	.008
0	0	.020	.012	-.007	-.014
0	2	.100	.015	-.020	-.036
0	4	.190	.022	-.034	-.056
0	6	.293	.038	-.051	-.080
0	8	.398	.062	-.068	-.103
0	10	.501	.092	-.084	-.127
0	12	.602	.130	-.100	-.146
0	14	.688	.172	-.108	-.156
0	16	.741	.220	-.099	-.180
0	18	---	.270	---	-.220
-4	-16	-.820	.248	.151	---
-4	-14	-.780	.202	.158	.225
-4	-12	-.684	.152	.144	.207
-4	-10	-.575	.109	.123	.181
-4	-8	-.463	.073	.107	.157
-4	-6	-.357	.046	.086	.130
-4	-4	-.250	.028	.067	.100
-4	-2	-.160	.018	.052	.075
-4	0	-.071	.014	.037	.053
-4	2	.010	.014	.027	.030
-4	4	.100	.017	.013	.008
-4	6	.200	.029	-.003	-.012
-4	8	.302	.046	-.019	-.032
-4	10	.406	.074	-.036	-.051
-4	12	.507	.106	-.048	-.067
-4	14	.592	.147	-.052	-.079
-4	16	.666	.192	-.060	-.131
-4	18	.771	.235	-.083	-.174
-12	-16	-.940	.316	.213	---
-12	-14	-.930	.259	.239	.360
-12	-12	-.847	.214	.233	.385
-12	-10	-.749	.170	.225	.393
-12	-8	-.651	.127	.209	.375
-12	-6	-.544	.090	.189	.340
-12	-4	-.425	.063	.161	.282
-12	-2	-.338	.046	.146	.265
-12	0	-.250	.034	.132	.240
-12	2	-.165	.026	.121	.209
-12	4	-.077	.024	.106	.180
-12	6	.019	.027	.091	.148
-12	8	.120	.038	.075	.123
-12	10	.222	.056	.060	.095
-12	12	.318	.081	.051	.079
-12	14	.405	.115	.034	.026
-12	16	.514	.156	.015	.009
-12	18	.618	.208	-.010	.023
-16	-16	-.958	.328	.237	---
-16	-14	-.955	.280	.251	---
-16	-12	-.872	.232	.246	---
-16	-10	-.762	.186	.236	---
-16	-8	-.670	.143	.223	---
-16	-6	-.567	.108	.206	---
-16	-4	-.470	.081	.186	---
-16	-2	-.382	.063	.171	---
-16	0	-.300	.049	.155	---
-16	2	-.220	.040	.149	---
-16	4	-.130	.025	.136	.297
-16	6	-.036	.025	.120	.269
-16	8	.057	.044	.107	.239
-16	10	.156	.060	.094	.216
-16	12	.243	.082	.084	.189
-16	14	.346	.111	.067	.125
-16	16	.452	.151	.053	.091
-16	18	.540	.197	.026	.067

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Table IX.– Aerodynamic characteristics of a triangular wing and a fuselage for various flap angles.   Reynolds number, 5,300,000 ; Mach number, 0.90.

| δ	α	C_L	C_D	C_m	C_h	δ	α	C_L	C_D	C_m	C_h
0	-12	0.630	0.138	0.116	0.179	-4	-12	-0.723	0.165	---	---
0	-10	-.500	.094	.083	.131	-4	-10	-.608	.121	0.151	0.204
0	-8	-.376	.062	.041	.090	-4	-8	-.494	.083	.130	.173
0	-6	-.273	.037	.038	.058	-4	-6	-.382	.053	.105	.148
0	-4	-.167	.022	.022	.031	-4	-4	-.267	.032	.080	.117
0	-2	-.071	.015	.005	.008	-4	-2	-.172	.021	.059	.088
0	0	.021	.013	-.008	-.013	-4	0	-.082	.015	.043	.060
0	2	.107	.016	-.024	-.036	-4	2	.007	.015	.026	.036
0	4	.208	.024	-.039	-.060	-4	4	.107	.019	.011	.015
0	6	.306	.041	-.056	-.088	-4	6	.208	.032	-.005	-.008
0	8	.417	.068	-.075	-.127	-4	8	.316	.054	-.025	-.032
0	10	.529	.103	-.102	-.173	-4	10	.422	.083	-.046	-.057
0	12	.642	.147	-.133	-.218	-4	12	.528	.123	-.068	-.084
0	14	.761	.207	---	---	-4	14	.635	.174	-.093	-.122
0	16	.882	---	---	---	-4	16	.754	---	---	---
4	-12	-.524	.117	.059	.067	-8	-12	-.796	.196	---	---
4	-10	-.404	.078	.034	.033	-8	-10	-.696	.150	.215	---
4	-8	-.292	.049	.012	.007	-8	-8	-.590	.109	.192	.294
4	-6	-.184	.030	-.006	-.017	-8	-6	-.476	.077	.166	.282
4	-4	-.085	.020	-.023	-.039	-8	-4	-.370	.053	.143	.267
4	-2	.017	.016	-.041	-.061	-8	-2	-.270	.036	.119	.240
4	0	.110	.020	-.055	-.084	-8	0	-.175	.027	.102	.214
4	2	.197	.029	-.068	-.118	-8	2	-.087	.022	.087	.187
4	4	.300	.040	-.086	-.155	-8	4	.008	.022	.069	.155
4	6	.410	.061	-.111	-.194	-8	6	.115	.032	.052	.126
4	8	.523	.091	-.133	-.238	-8	8	.222	.049	.031	.100
4	10	.640	.130	-.162	-.283	-8	10	.322	.073	.010	.090
4	12	.770	.176	-.191	---	-8	12	.421	.105	-.004	.040
4	14	---	.246	---	---	-8	14	.525	.147	-.020	-.032
4	16	---	---	---	---	-8	16	.640	---	-.047	---
-2	-12	-.678	.151	.149	.213	-12	-12	---	.230	---	---
-2	-10	-.554	.106	.113	.177	-12	-10	-.735	.176	.242	.402
-2	-8	-.437	.071	.090	.138	-12	-8	-.631	.134	.228	.403
-2	-6	-.325	.045	.070	.104	-12	-6	-.533	.100	.204	.402
-2	-4	-.210	.027	.047	.073	-12	-4	-.430	.073	.180	.389
-2	-2	-.120	.017	.030	.046	-12	-2	-.338	.055	.159	.362
-2	0	-.030	.014	.017	.022	-12	0	-.242	.043	.142	.322
-2	2	.060	.015	.000	-.001	-12	2	-.156	.034	.129	.286
-2	4	.158	.022	-.015	-.024	-12	4	-.069	.031	.114	.258
-2	6	.258	.037	-.032	-.048	-12	6	.033	.037	.097	.234
-2	8	.365	.059	-.051	-.074	-12	8	.137	.050	.080	.211
-2	10	.474	.092	-.075	-.120	-12	10	.240	.069	.063	.190
-2	12	.584	.134	-.103	-.167	-12	12	.338	.099	.047	.205
-2	14	.698	.190	---	---	-12	14	.440	.135	.032	.160
-2	16	.820	---	---	---	-12	16	.551	.188	.001	---
						-14	-12	---	.247	---	---
						-14	-10	-.738	.190	.252	---
						-14	-8	-.633	.147	.242	---
						-14	-6	-.539	.112	.215	---
						-14	-4	-.440	.083	.189	---
						-14	-2	-.355	.064	.169	---
						-14	0	-.265	.051	.151	---
						-14	2	-.177	.039	.138	---
						-14	4	-.095	.037	.126	.311
						-14	6	.005	.042	.112	.291
						-14	8	.100	.054	.096	.278
						-14	10	.210	.074	.080	.256
						-14	12	.308	.102	.068	.270
						-14	14	.419	.141	.049	.219
						-14	16	.530	.186	.009	---

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0.028 Gap

Dimensions shown in inches
unless otherwise noted.

Hinge line

Ridge line

63.43° MAC = 48.00

36.00

12.00

72.00 7.60

Wing planform
Sharp leading edge,
sharp ridge lines

63.03° MAC = 47.14

36.00

70.73 7.60

Wing planform
Rounded leading edge,
rounded ridge lines

0.2000c

Sym ₵ 0.0500c

Sharp ridge,
sharp L.E.

0.2000c 0.0250c

0.0250c

Sym ₵ 0.0484c

r = 0.3222c

Round ridge,
sharp L.E.

0.0176c

Sym ₵

r = 0.0025c

Round ridge,
round L.E.

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Figure 1. – Semispan model of a triangular wing of aspect
ratio 2 tested in the Ames 12-foot pressure wind tunnel.
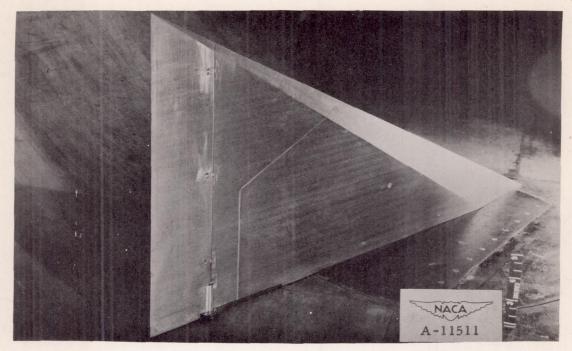
Figure 2.— The semispan triangular wing with sharp ridge lines and sharp leading edge mounted in the Ames 12—foot pressure wind tunnel.
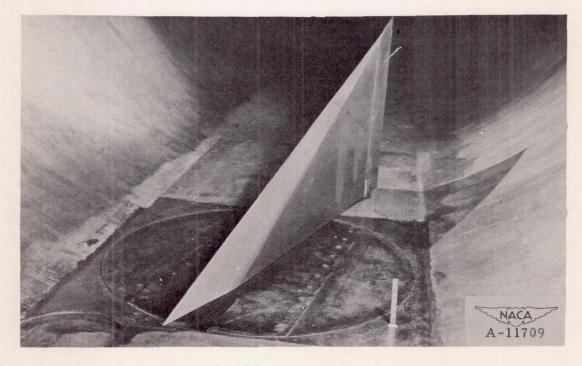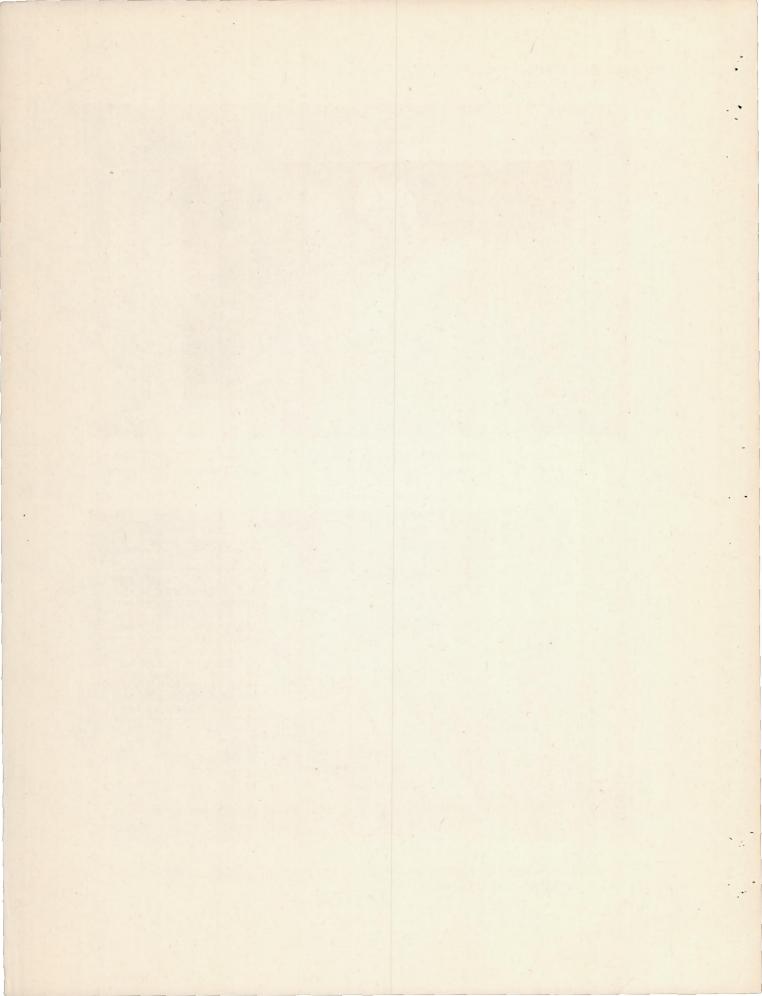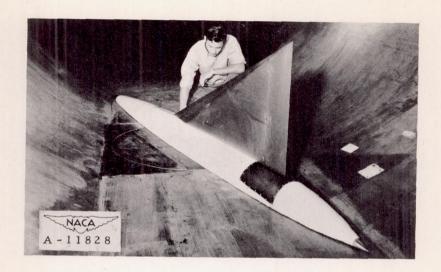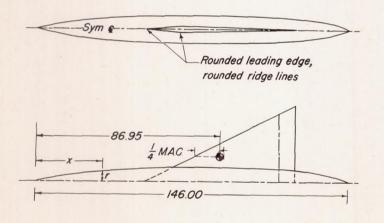
Figure 3.— The triangular wing with rounded ridge lines and a rounded leading edge.

Note: Dimensions shown in inches

Rounded leading edge,
rounded ridge lines

86.95

$\frac{1}{4}$ MAC.

x

r

146.00
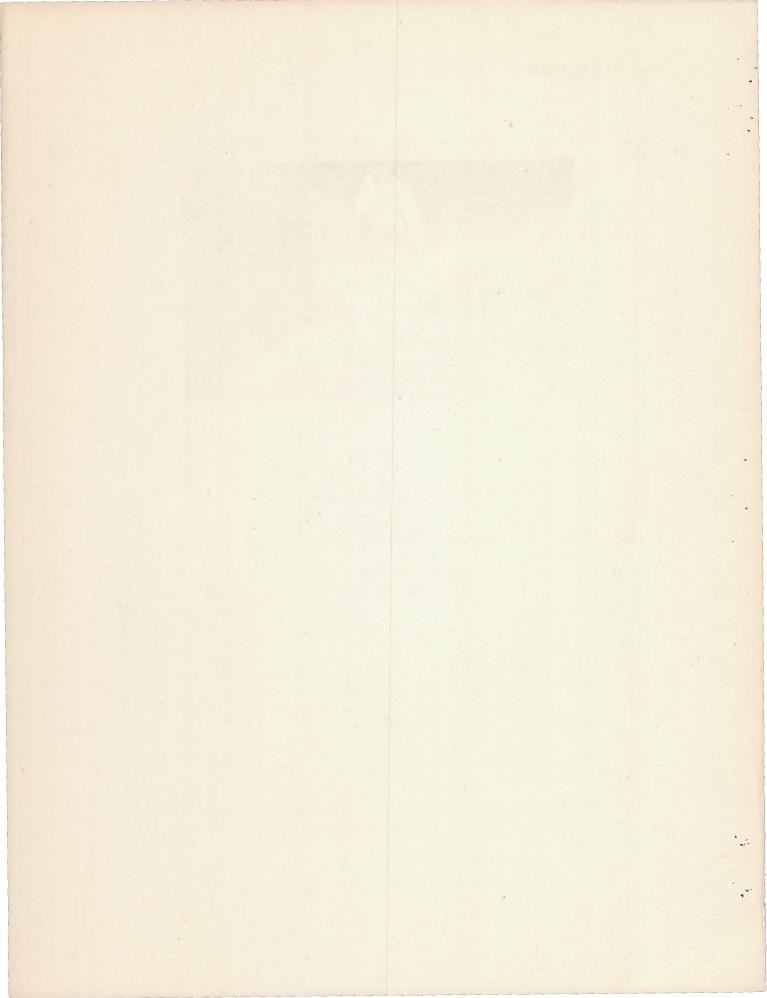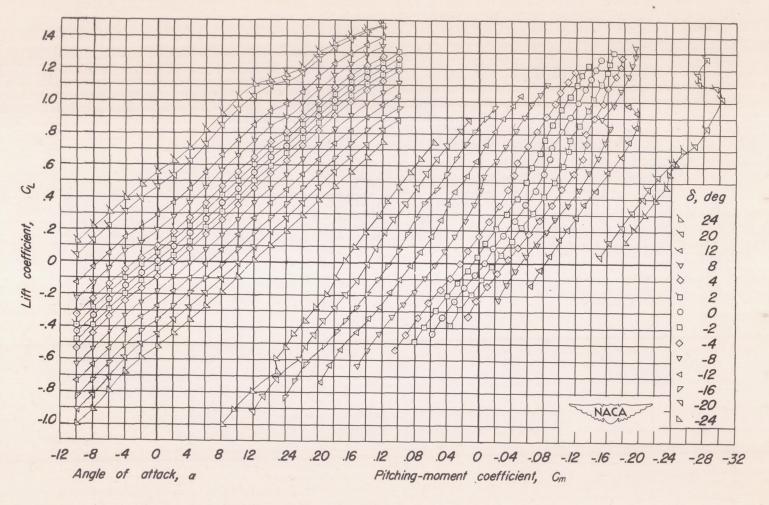
Body coordinates Percent length			
x	r	x	r
0	0	61.60	4.398
3.42	0.904	68.50	4.252
6.85	1.480	75.30	3.992
10.27	1.958	83.20	3.575
13.70	2.370	84.95	3.445
20.55	3.034	86.30	3.310
27.40	3.553	89.00	2.938
34.23	3.939	91.80	2.460
41.10	4.211	94.50	1.835
47.92	4.375	97.30	1.034
54.80	4.430	99.30	0.293
55.50	4.439	100.00	0

Figure 4.- The wing-body combination tested in the Ames 12-foot pressure wind tunnel.
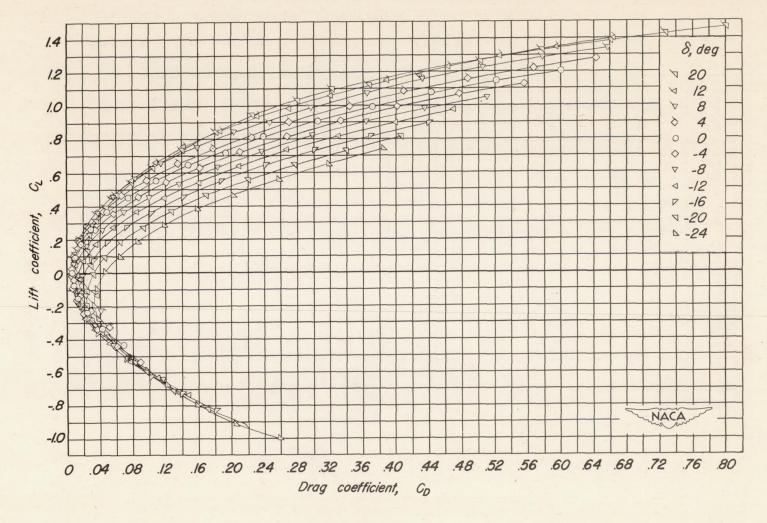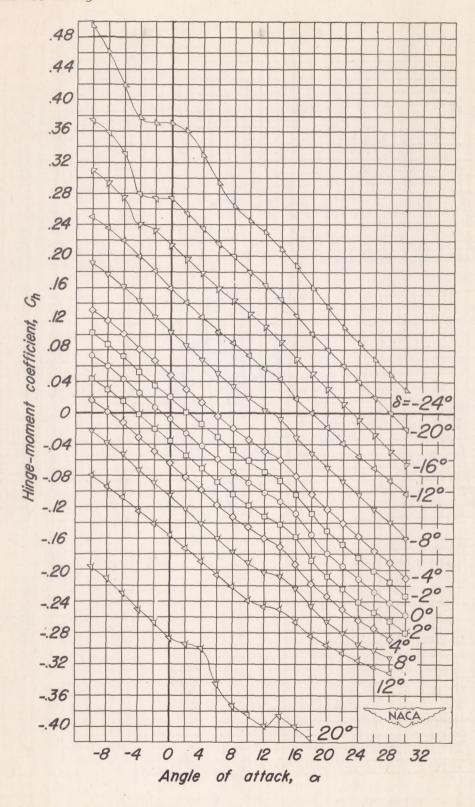
(a) C_L vs α, C_L vs C_m

Figure 5.- The aerodynamic characteristics of a triangular wing with various flap angles.

Reynolds number, 15,000,000; Mach number, 0.18.
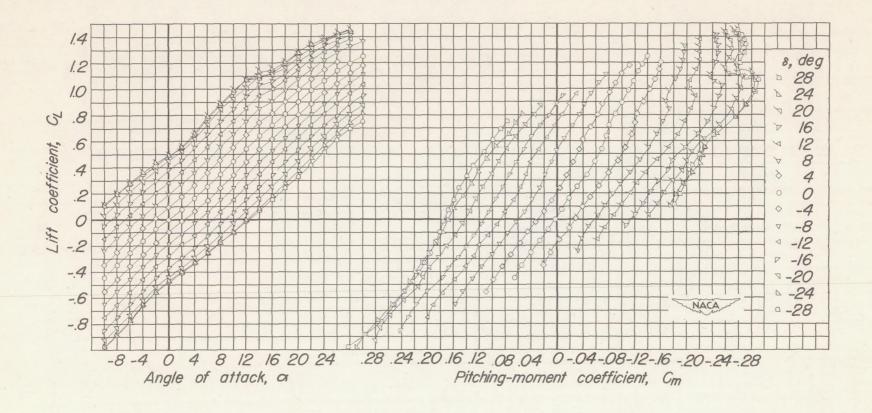
(b) C_L vs C_D

Figure 5.-Continued.

(c) C_h vs α
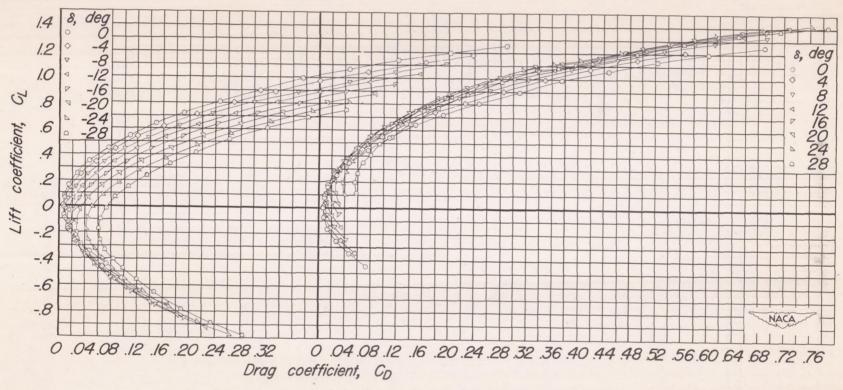
Figure 5.-Concluded.
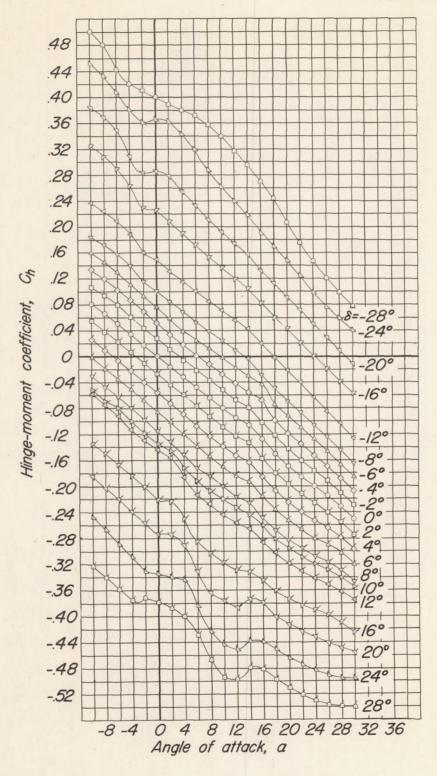
(a) C_L vs a, C_L vs C_m

Figure 6.- The aerodynamic characteristics of a triangular wing with various flap angles
Reynolds number, 5,300,000; Mach number, 0.18
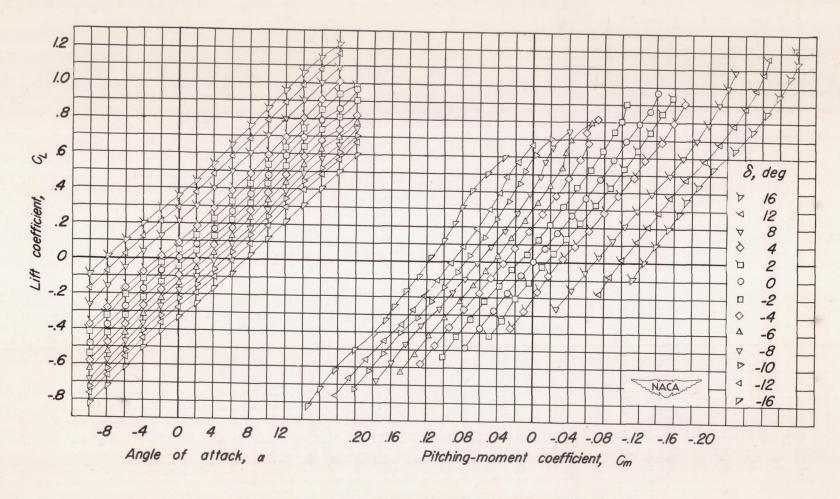
(b) C_L vs C_D

Figure 6.-Continued.

(c) C_h vs a

Figure 6.-Concluded.

(a) C_L vs a, C_L vs C_m

Figure 7.- The aerodynamic characteristics of a triangular wing with various flap angles.
Reynold number, 5,300,000; Mach number, 0.70.

(b) C_L vs C_D
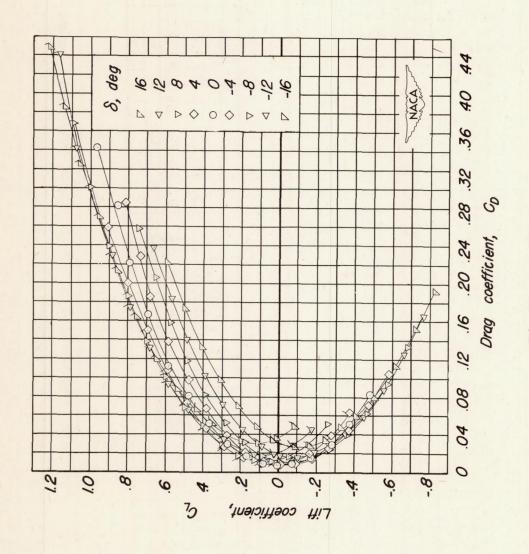
Figure 7.-Continued.

(c) C_h vs a
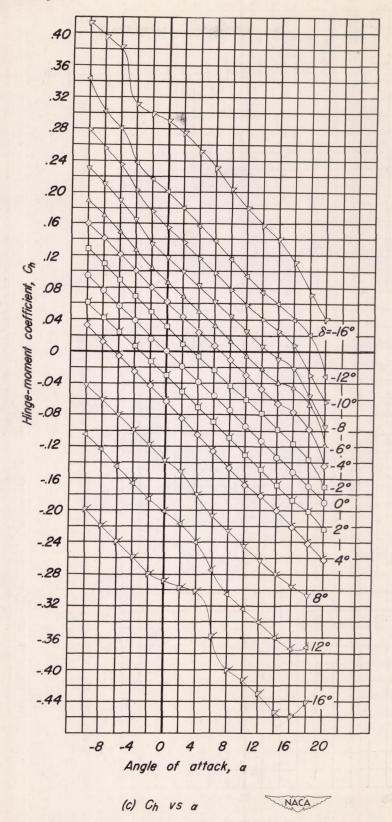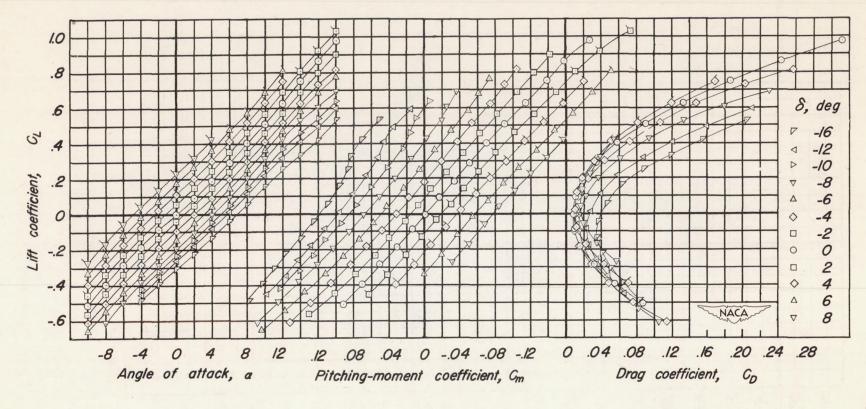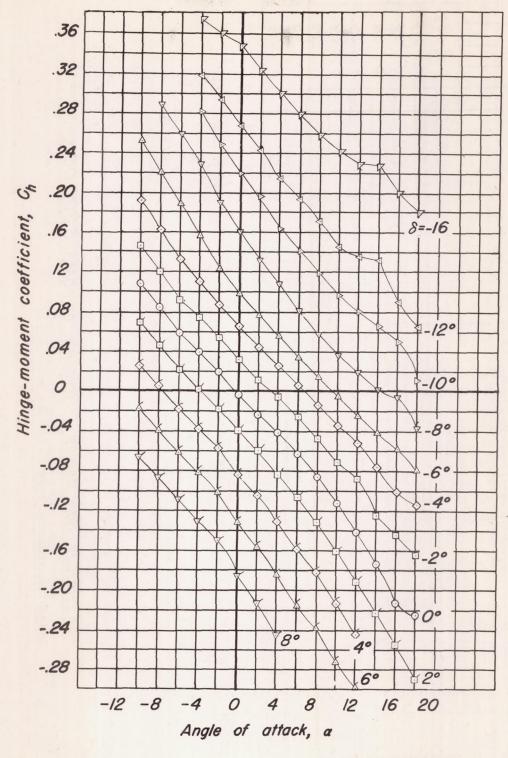
Figure 7.-Concluded.

(a) C_L vs α, C_L vs C_m, C_L vs C_D

Figure 8.- The aerodynamic characteristics of a triangular wing with various flap angles. Reynolds number, 5,300,000; Mach number, 0.85.
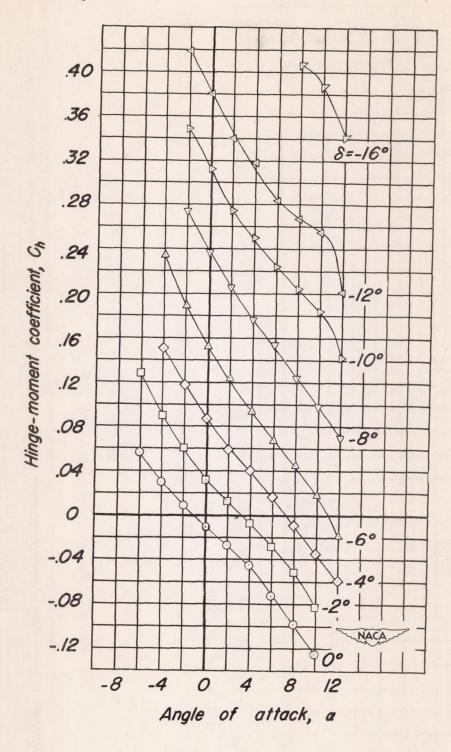
(b) C_h vs a

Figure 8.-Concluded.
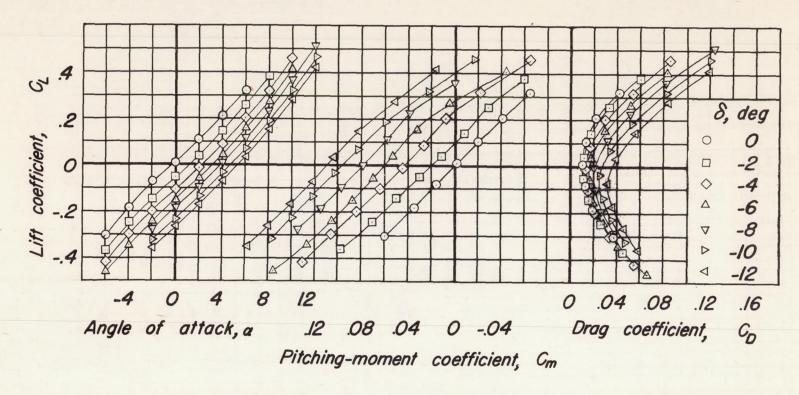
(a) C_L vs α, C_L vs C_m, C_L vs C_D

Figure 9.- The aerodynamic characteristics of a triangular wing with various flap angles. Reynolds number, 5,300,000; Mach number, 0.93.

(b) C_h vs a

Figure 9.-Concluded.
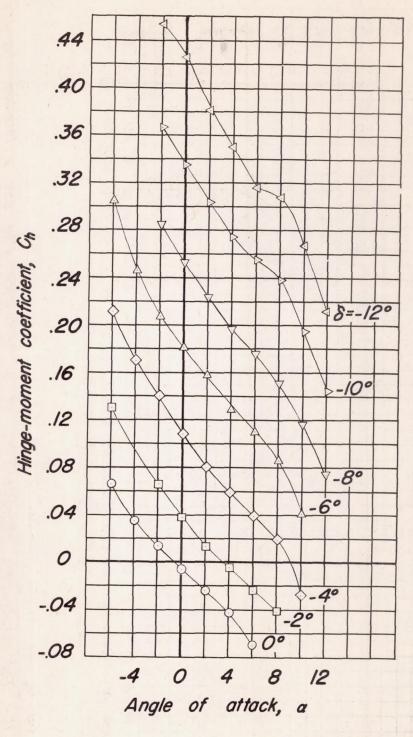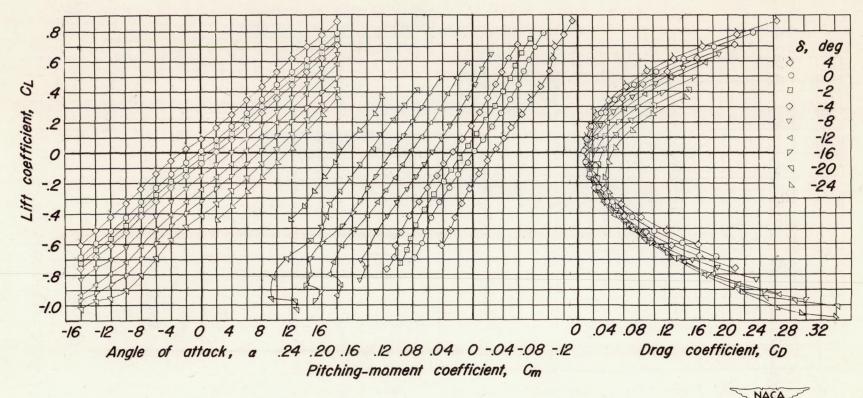
(a) C_L vs a, C_L vs C_m, C_L vs C_D

Figure 10.- The aerodynamic characteristics of a triangular wing with various flap angles. Reynolds number, 5,300,000; Mach number, 0.95.
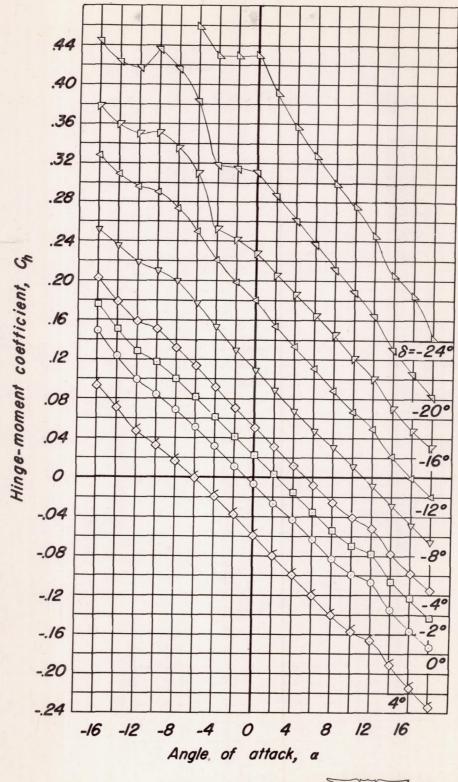
(b) C_h vs a

Figure 10.-Concluded.
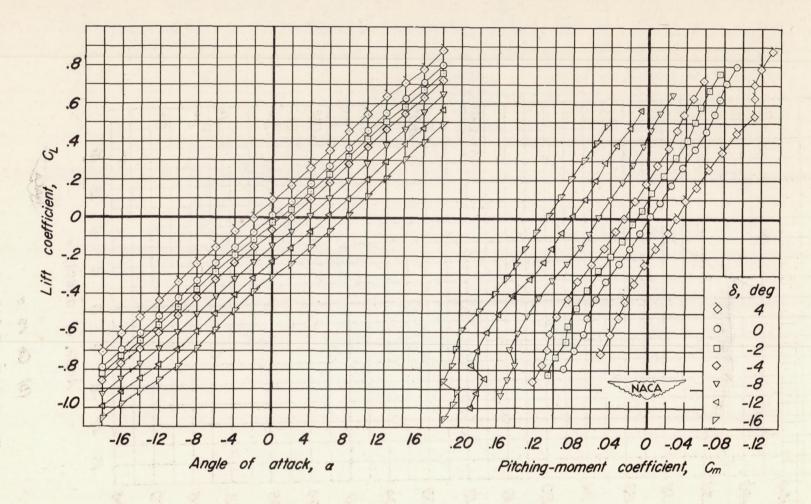
(a) C_L vs a, C_L vs C_m, C_L vs C_D

Figure II.- The aerodynamic characteristics of a triangular wing and a fuselage for various flap angles. Reynolds number, 15,000,000; Mach number, 0.18.

(b) C_h vs a

Figure 11.-Concluded.
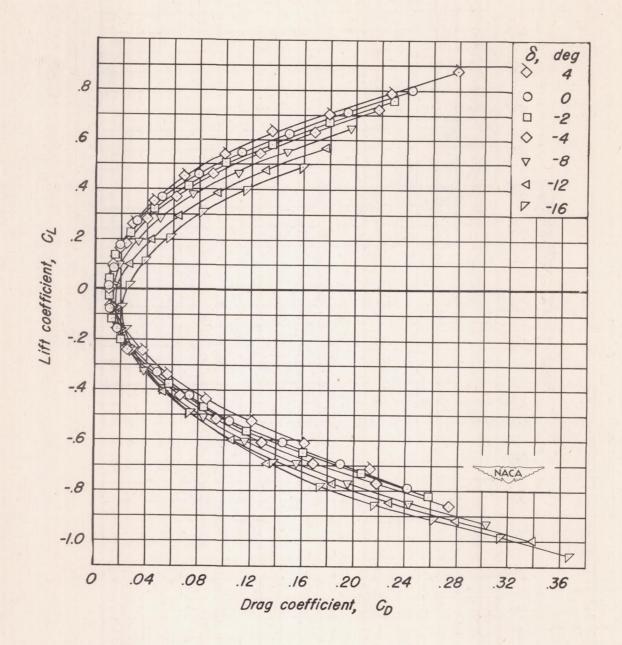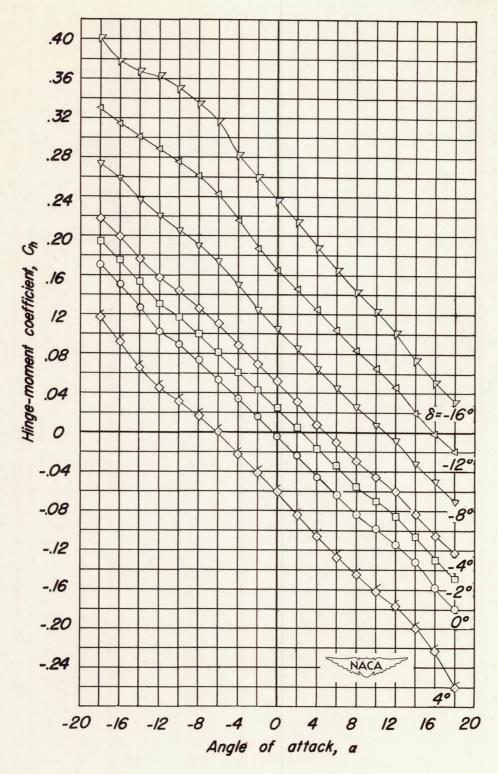
(a) C_L vs a, C_L vs C_m
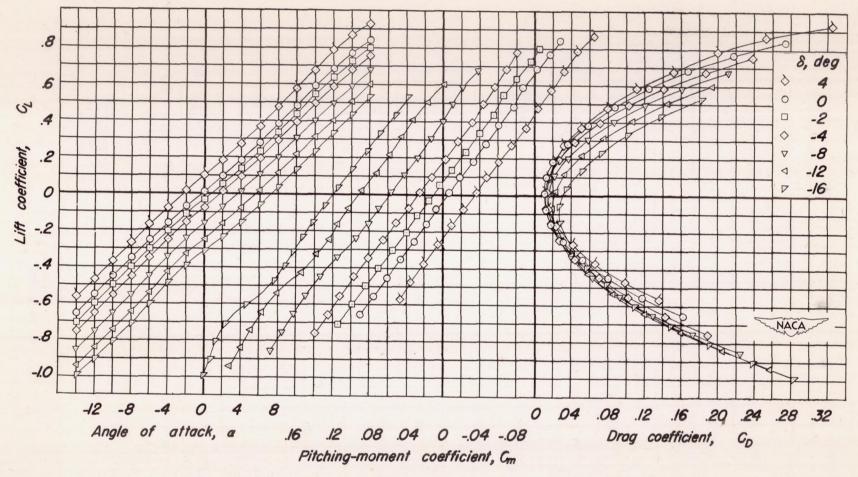
Figure 12.- The aerodynamic characteristics of a triangular wing and a fuselage for various flap angles. Reynolds number, 5,300,000; Mach number, 0.3.

(b) C_L vs C_D

Figure 12.-Continued

(c) C_h vs α
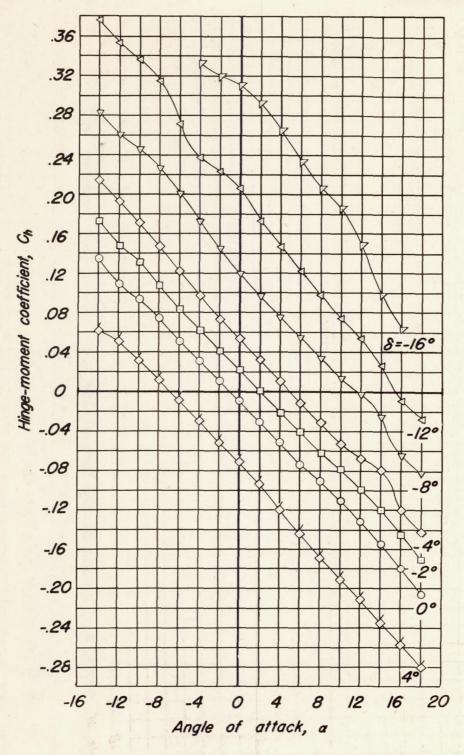
Figure 12.-Concluded.
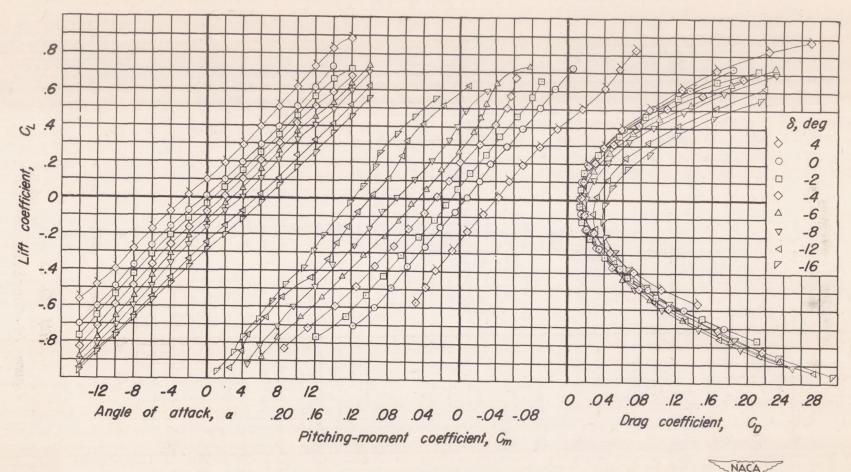
(a) C_L vs α, C_L vs C_m, C_L vs C_D

Figure 13.- The aerodynamic characteristics of a triangular wing and fuselage for various flap angles. Reynolds number, 5,300,000; Mach number, 0.70.
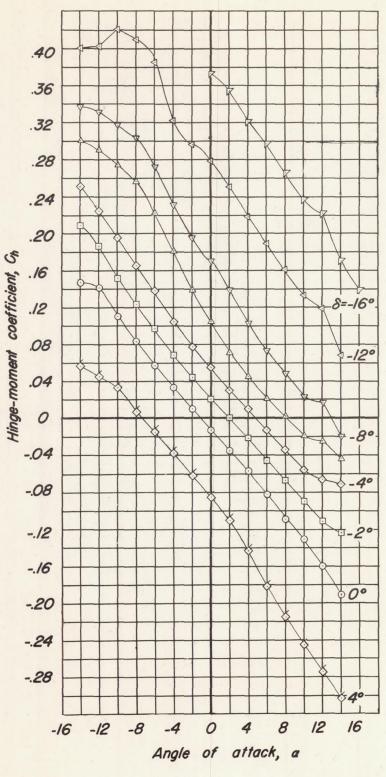
(b) C_h vs a

Figure 13.-Concluded.

(a) C_L vs a, C_L vs C_m, C_L vs C_D

Figure 14.- The aerodynamic characteristics of a triangular wing and a fuselage for various flap angles. Reynolds number, 5,300,000; Mach number, 0.85.

(b) C_h vs a

Figure 14.-Concluded.

(a) C_L vs a, C_L vs C_m, C_L vs C_D
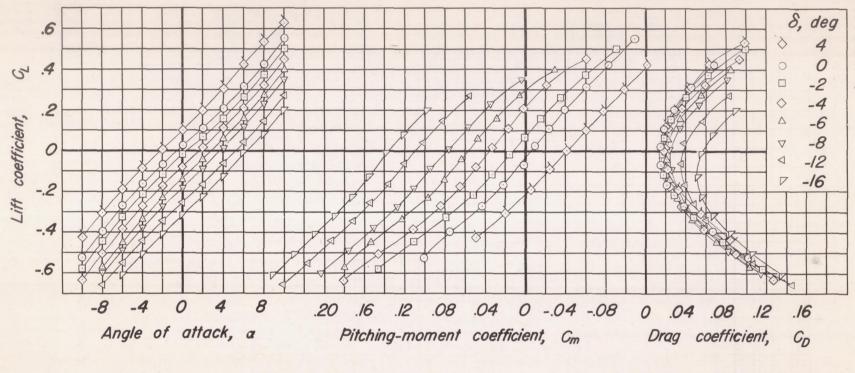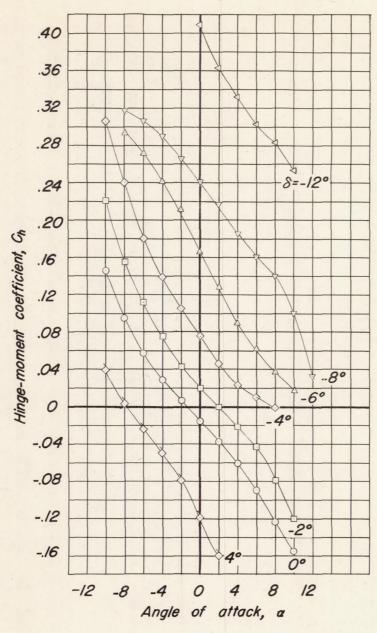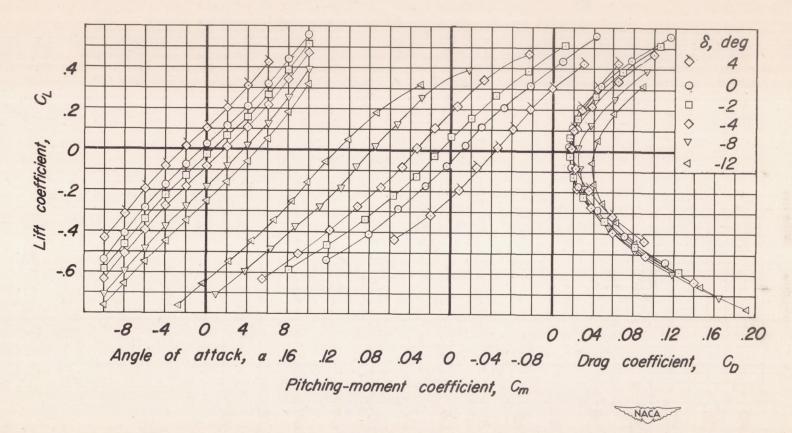
Figure 15.- The aerodynamic characteristics of a triangular wing and a fuselage for various flap angles. Reynolds number, 5,300,000; Mach number, 0.93.
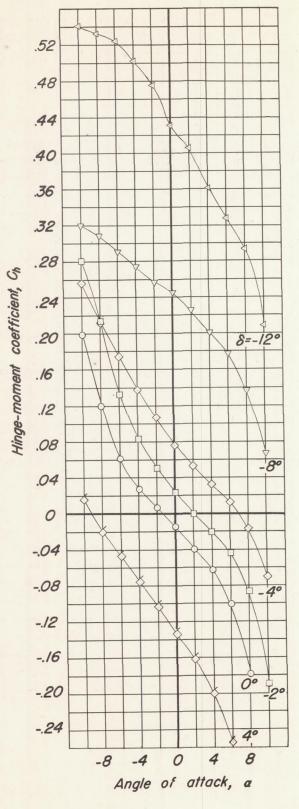
(b) C_h vs a

Figure 15.-Concluded.

(a) C_L vs α, C_L vs C_m, C_L vs C_D

Figure 16.- The aerodynamic characteristics of a triangular wing
and a fuselage for various flap angles.
Reynolds number, 5,300,000, Mach number, 0.95.

(b) C_h vs α

Figure 16.-Concluded.
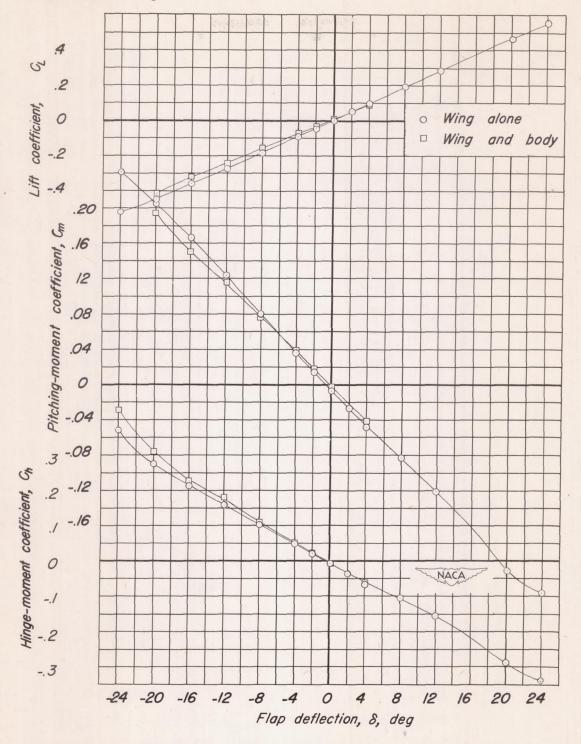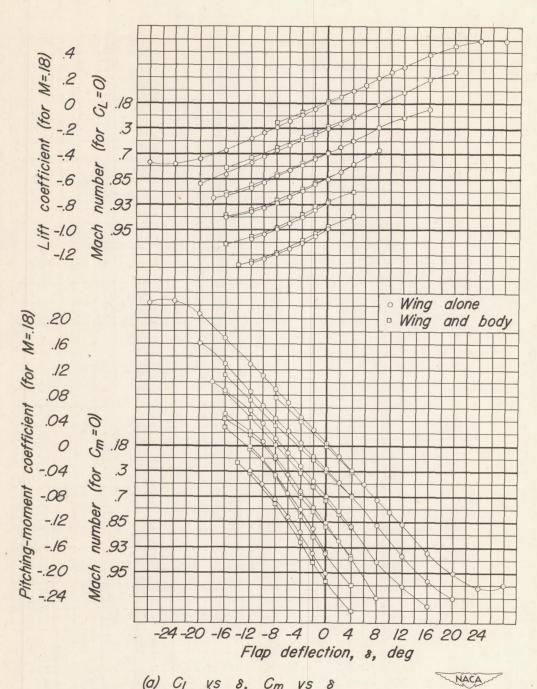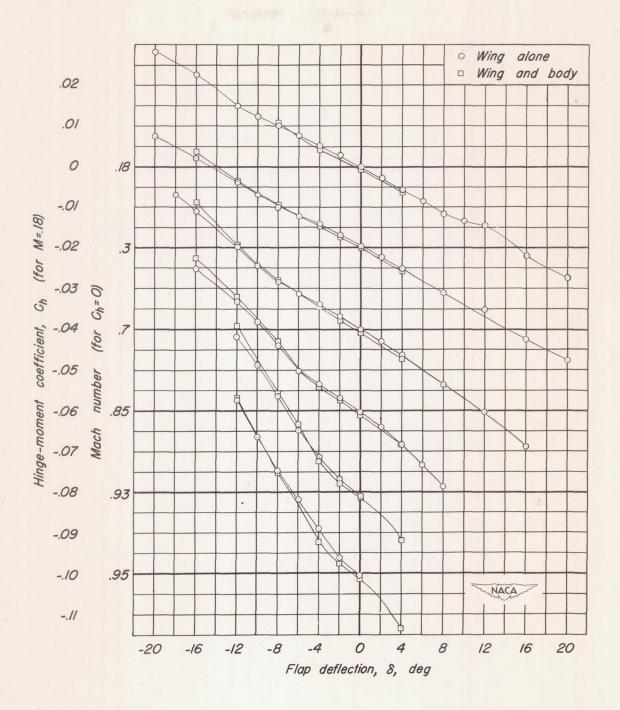
Figure 17.- The variation of lift, pitching-moment, and hinge-moment coefficient with flap deflection for a triangular wing alone and with a fuselage. Reynolds number, 15,000,000; Mach number, 0.18; Angle of attack, 0°.

(a) C_L vs δ, C_m vs δ

Figure 18.-The variation of lift, pitching-moment and
hinge-moment coefficients with flap deflection for
a   triangular wing alone and with a fuselage   at
several Mach numbers. Reynolds number, 5,300,000;
Angle of attack, 0°.

(b) C_h vs δ

Figure 18.-Concluded
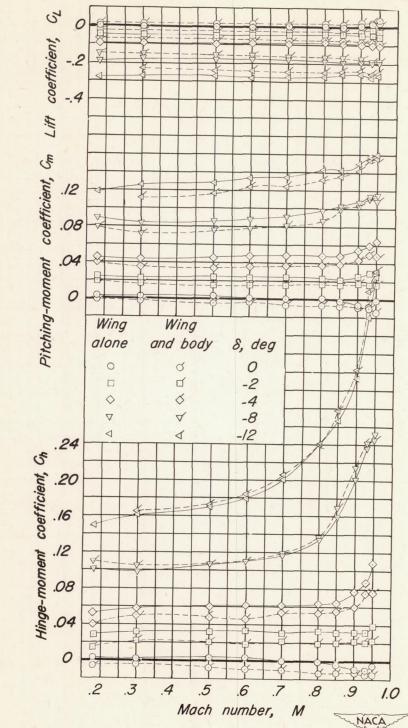
Figure 19.-The effect of Mach number on the lift, pitching-moment and hinge-moment coefficients of a triangular wing alone and with a fuselage for various flap angles. Reynolds number, 5,300,000. Angle of attack, 0.°
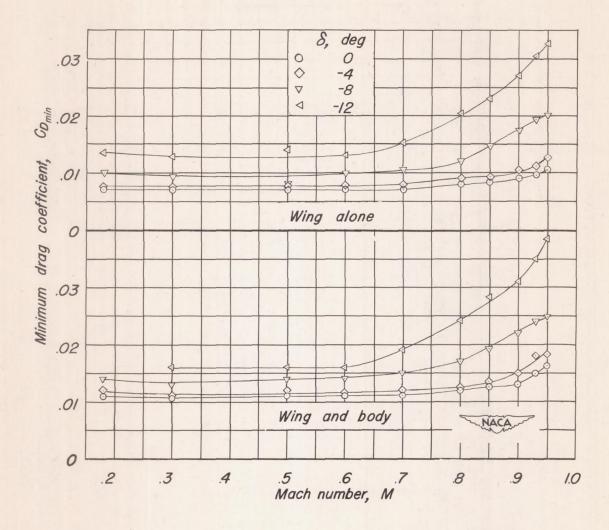
Figure 20.-The effect of Mach number on the minimum drag coefficient of a triangular wing alone and with a fuselage for various flap angles. Reynolds number, 5,300,000.
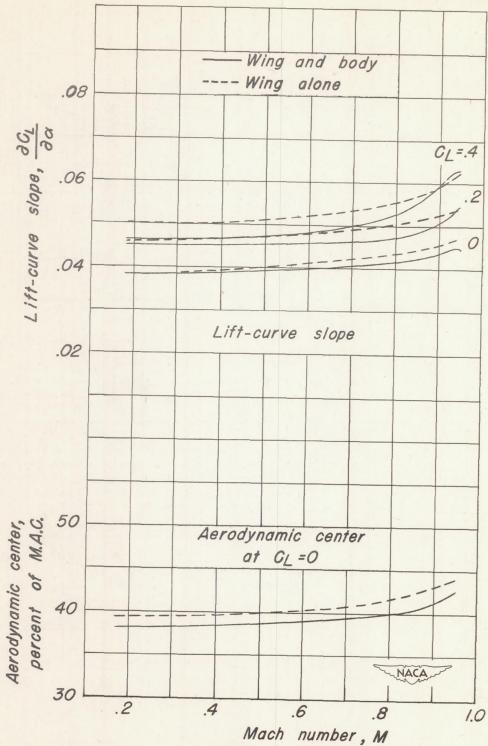
Figure 21.- The effect of Mach number on lift-curve slope and aerodynamic center of a triangular wing alone and with a fuselage at a Reynolds number of 5,300,000.
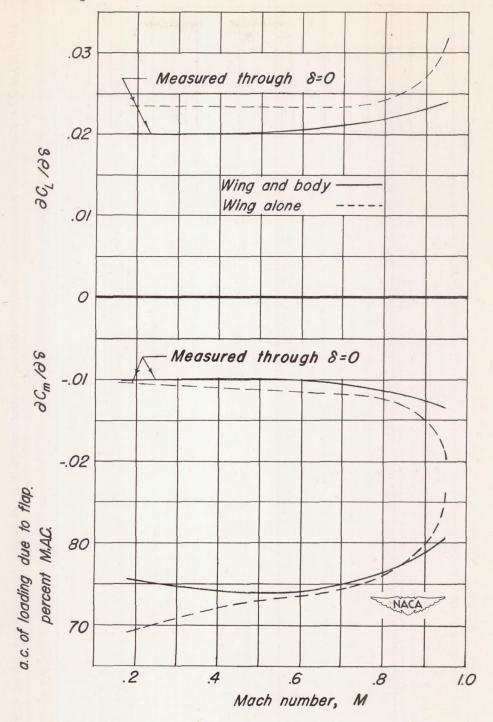
Figure 22.-The variation with Mach number of the flap effectiveness and aerodynamic center of the loading due to the flap for a triangular wing alone and with a fuselage. Reynolds number, 5,300,000. Angle of attack, 0°.
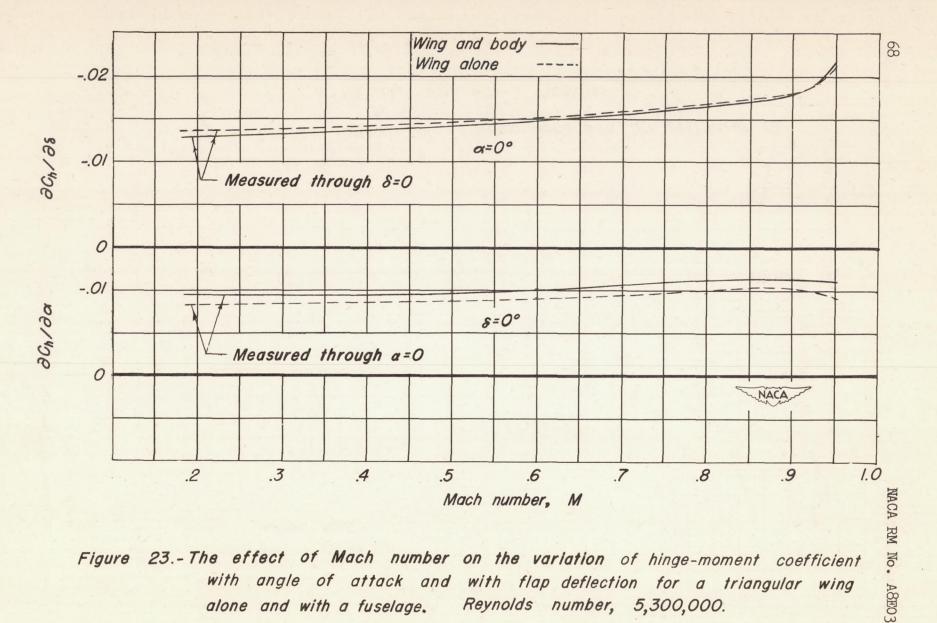
Figure 23.- The effect of Mach number on the variation of hinge-moment coefficient with angle of attack and with flap deflection for a triangular wing alone and with a fuselage. Reynolds number, 5,300,000.
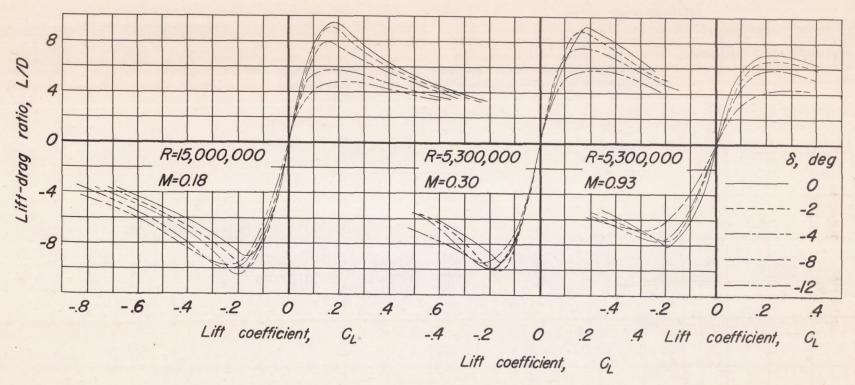
Figure 24.-The variation of lift-drag ratio with lift coefficient for a triangular wing with a fuselage.
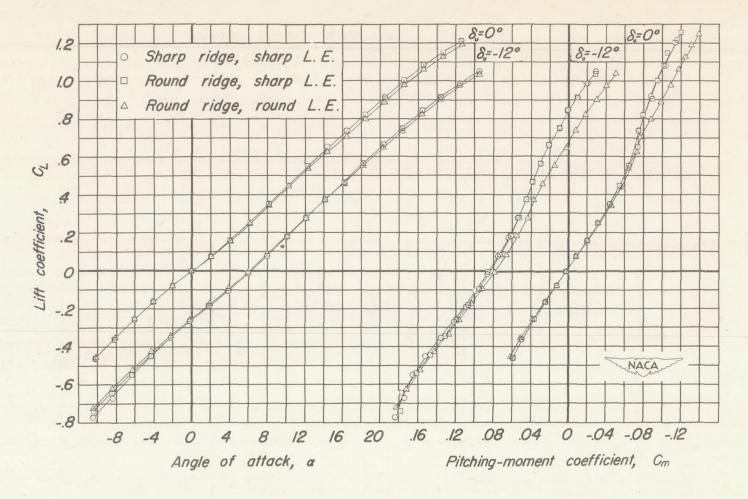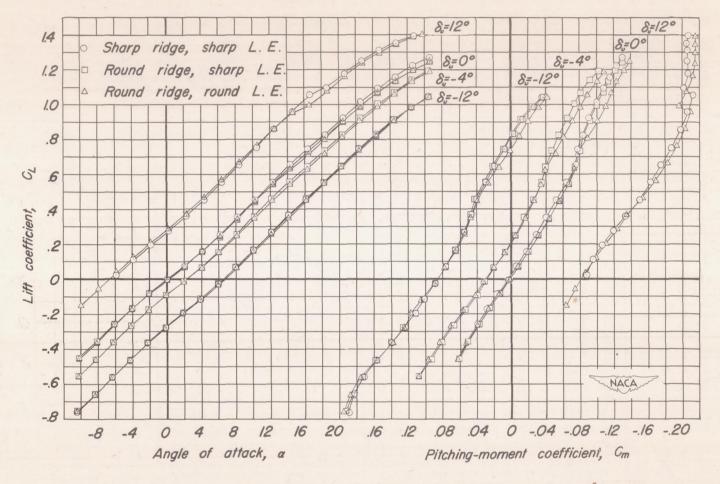
Figure 25.-The effect of minor modifications to the wing profile on the lift and pitching-moment characteristics of a triangular wing. Reynolds number, 15,000,000; Mach number, 0.18.
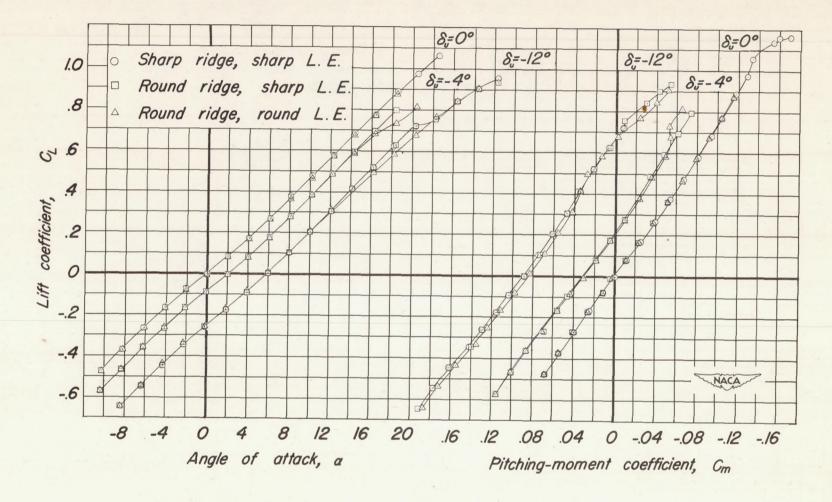
(a) Mach number, 0.18.
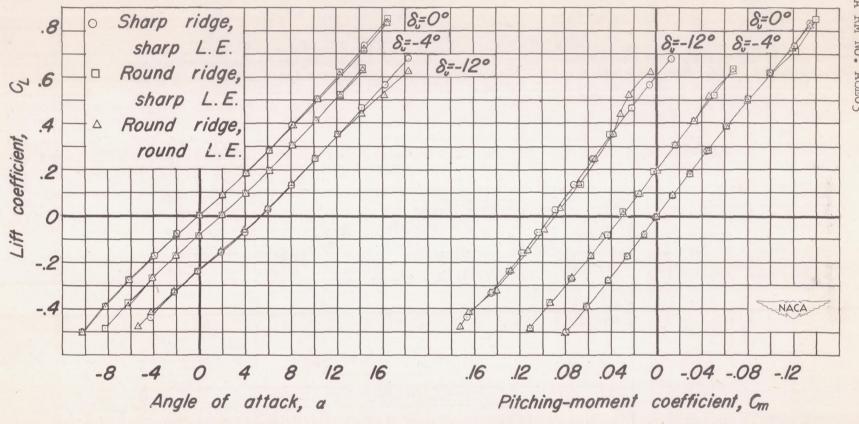
Figure 26.-The effect of minor modifications to the wing profile on the lift
and pitching-moment characteristics of a triangular wing.
Reynolds number, 5,300,000.
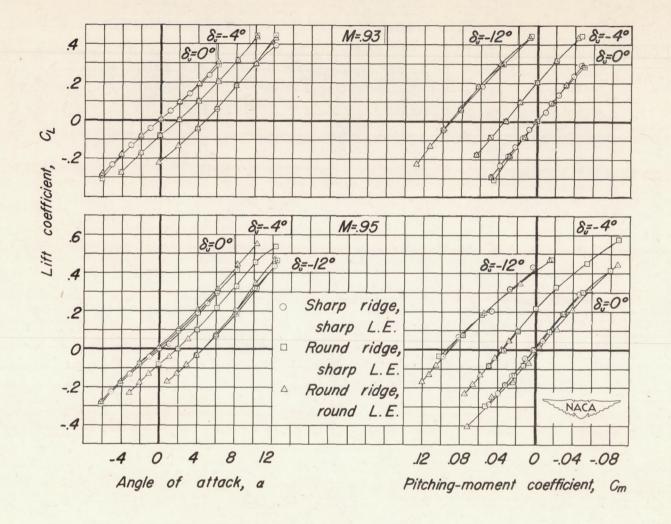
(b) Mach number, 0.70.

Figure 26.-Continued.

(c) Mach number, 0.85.

Figure 26.-Continued.

(d) Mach numbers, 0.93, 0.95.

Figure 26.-Concluded.
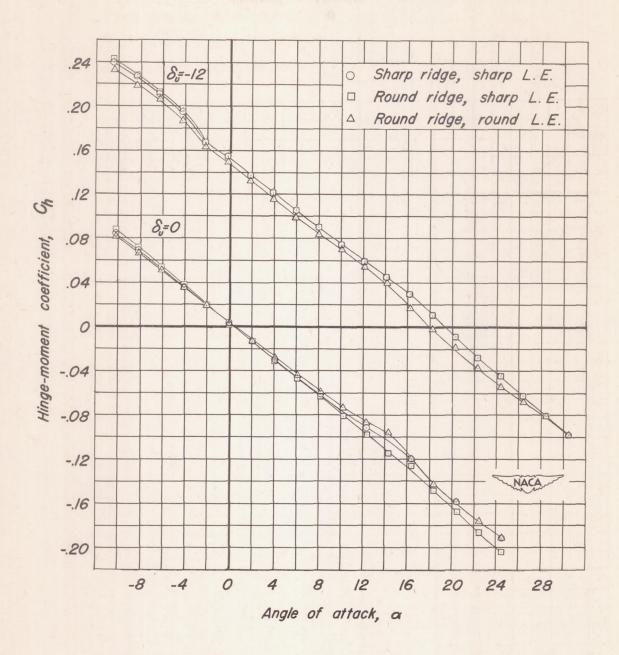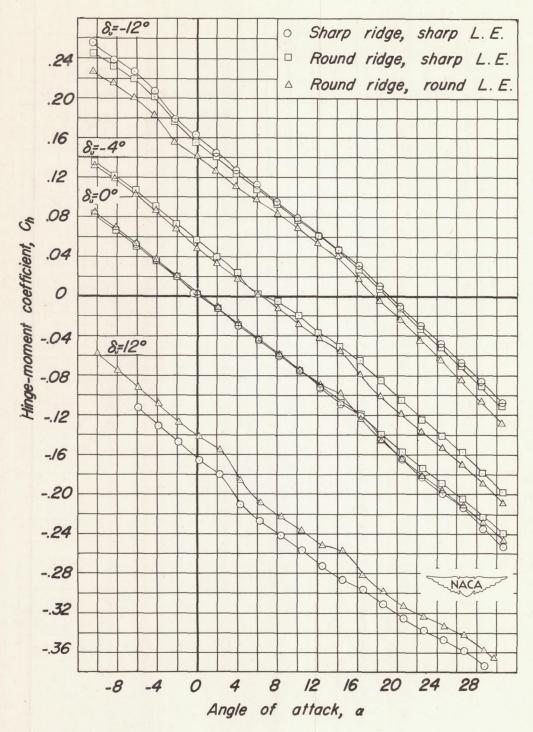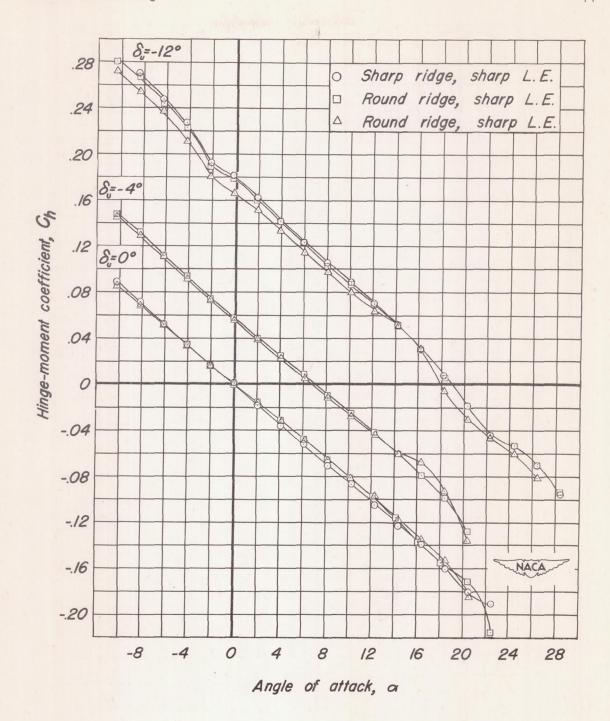
Figure 27.-The effect of minor modifications to the wing profile on the hinge-moment characteristics of a triangular wing. Reynolds number, 15,000,000; Mach number, 0.18.
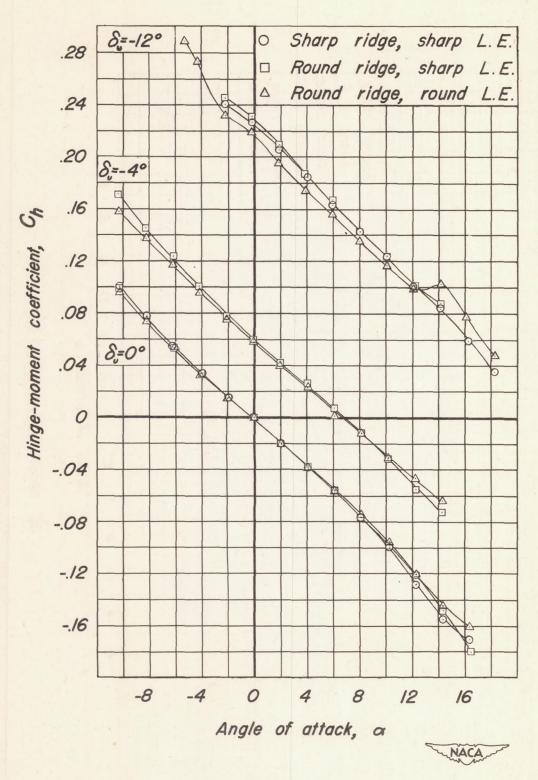
(a)   Mach   number,   0.18.
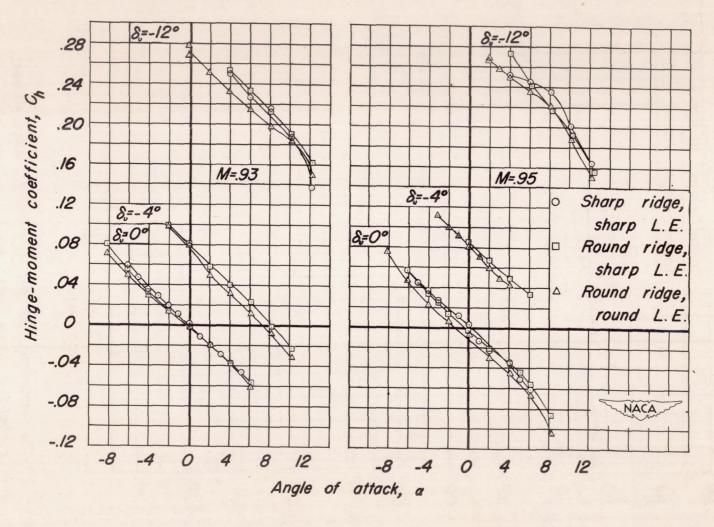
Figure 28.-The effect of minor modifications   to   the
wing   profile   on   the   hinge-moment   characteristics
of   a   triangular   wing.   Reynolds   number,   5,300,000.

(b) Mach number, 0.70

Figure 28.-Continued.

(c) Mach number, 0.85.

Figure 28.-Continued.

(d) Mach numbers, 0.93, 0.95.

Figure 28.-Concluded.
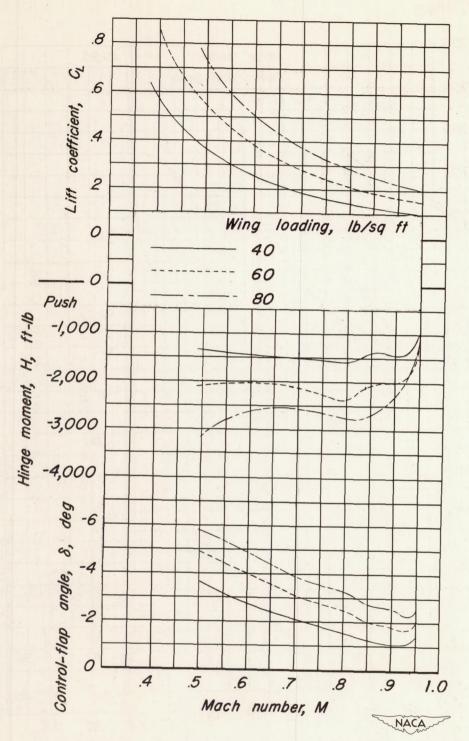
Figure 29.-The variations of lift coefficient, hinge moment, and control-flap angle with Mach number for level flight of a triangular winged aircraft at 30,000 feet altitude. Wing area, 500 sq ft; c.g. at 0.32 M.A.C.
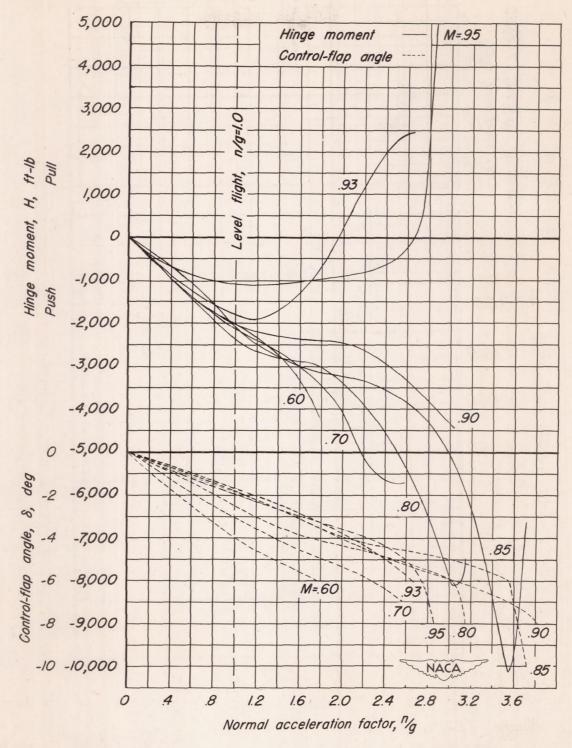
Figure 30.-The variations of hinge moment and control-flap angle with normal acceleration factor, at several Mach numbers, for a triangular winged aircraft at 30,000 feet altitude. Wing loading, 60 lb per sq ft; Wing area, 500 sq ft; c.g. at 0.32 M.A.C.
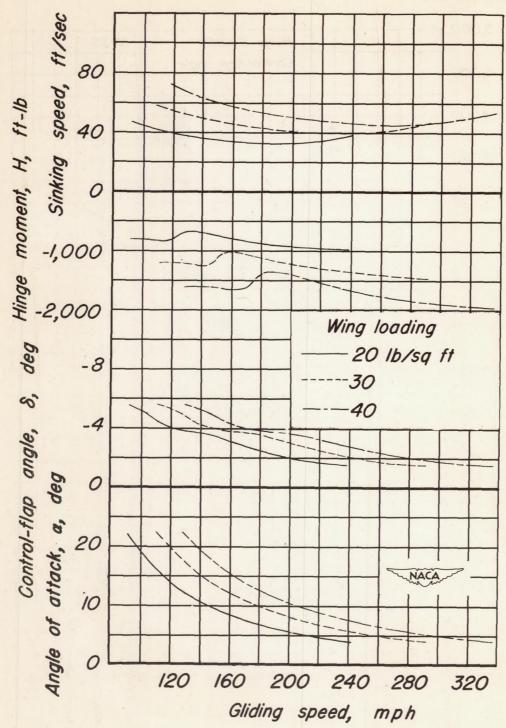
Figure 31.-The variations of sinking speed, hinge moment, and control-flap angle with gliding speed for a triangular winged aircraft at sea level. Wing area, 500 sq ft; c.g. at 0.32 M.A.C.